

National Aeronautics and Space Administration

The NASA logo, featuring the word "NASA" in a bold, sans-serif font, with a red swoosh and a blue circular emblem containing a white star and a red swoosh.

# ECONOMIC BENEFITS STUDY

*NASA Ames Research Center  
and NASA Research Park in Silicon Valley*

March 2010

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# *EXECUTIVE SUMMARY*





## Executive Summary

NASA Ames Research Center stands in a unique and unprecedented position to provide the technologies and expertise that enable NASA missions and address the great challenges facing our nation and planet: economic growth and future prosperity; scientific discovery and innovation; environmental degradation and climate change; and educating and inspiring our youth.

For over seventy years, NASA Ames' visionary leaders have promoted a unique organizational culture characterized by a willingness to try new ideas and explore the frontiers of science. NASA Ames is a critical part of Silicon Valley's world-renowned innovation ecosystem, actively participating in the valley's technological and scientific evolution.

The ongoing development of NASA Research Park, a major Ames initiative, has produced a collaborative community of government, industry, and academic leaders who are delivering innovation, powering economic growth, and advancing science, technology, engineering and math education.

NASA Ames currently generates \$1.3 billion in annual economic output, supporting over 8,400 jobs nationally, with 70% of these jobs remaining in California and more than 5,300 jobs and \$877 million in annual economic output in the San Francisco Bay Area alone.

NASA Research Park is a major success story with 70 on-site partners occupying approximately 675,000 square feet of building space. Upon full build-out over the next fifteen years, NASA Research Park will have a major economic impact, generating an additional 33,800 jobs nationally and \$5.8 billion in annual economic output. California stands to gain over 23,600 new permanent jobs, with the vast majority (21,300) in the San Francisco Bay Area.

The Center's current activities, along with NASA Research Park, represent an extraordinary economic force, with the potential to deliver up to 42,200 jobs nationally, supported by \$7.1 billion in total annual economic output.

*“Today, we must continue to cultivate new astronauts, scientists, robot designers, and computer engineers... if we are to remain competitive and retain our role as the technological leaders of the world.”*

*Charles Bolden, NASA Administrator*



*“NASA Ames has a 70-year record of path-breaking endeavors and a great location here in Silicon Valley. Looking forward, Ames is committed to revitalizing America’s space exploration programs through scientific and technological innovation, partnerships with private industry and academia, and recruiting top talent to NASA.”*

*Simon P. (Pete) Worden, Ph.D. Director, NASA Ames Research Center*

The Center provides leadership within NASA in the following fields:

- ▶ Astrobiology
- ▶ Atmospheric, biospheric, and airborne sciences
- ▶ Intelligent/adaptive systems
- ▶ Airspace systems
- ▶ Robotics
- ▶ Prognostics health management
- ▶ Earth sciences
- ▶ Supercomputing
- ▶ Entry, descent and landing, particularly advanced thermal protection systems
- ▶ Small satellites and related technologies
- ▶ Life sciences
- ▶ Information technology

## **NASA Ames Stimulates the Economy**

### **NASA Ames Profile**

NASA Ames is one of America’s premier research labs—a unique national asset of unquantifiable value. From small spacecraft to supercomputers, science missions and payloads to thermal protection systems, information technology to aerospace, NASA Ames provides products, technologies and services that enable NASA missions and expand human knowledge.

NASA Ames plays a critical role in virtually all NASA missions in support of America’s space and aeronautics programs. NASA Ames enables space exploration through interdisciplinary scientific research and innovative technology development.

While pursuing its missions, NASA Ames generates significant economic benefits, summarized in the following sections.

Ames also plays a key role in the Silicon Valley economy, specifically by:

- ▶ Investing in research and development
- ▶ Promoting innovation
- ▶ Advancing research in green and clean technologies
- ▶ Generating and transferring scientific and technological knowledge
- ▶ Facilitating commercialization of space
- ▶ Supporting STEM education and workforce development



### How NASA Ames Stimulates the Economy

With an overall budget of \$751 million in Fiscal Year 2008, NASA Ames employed approximately 1,300 civil servants and 1,200 contractor employees. NASA Ames' spending is mainly within California. Of the Center's total budget, approximately \$552 million translates into direct economic activity, while the remainder are tax payments and household savings. Of this net spending, \$531 million (or 96 percent) directly impacts businesses and households within California and \$523 million (or 95 percent) within the Bay Area. NASA Ames' own spending results in almost 3,600 jobs across the country with just under 3,400 in California, and slightly less than 3,300 within the Bay Area.

Santa Clara County is the largest single beneficiary of NASA Ames' spending. Approximately \$283 million of NASA dollars are spent within this county annually. The majority of NASA Ames employees live within 10 miles of the Center, concentrated in northern Santa Clara County.

NASA Ames awards 69 percent of its budget as contracts and grants to businesses, educational institutions, nonprofits, and other governmental entities. Salaries and benefits for civil servants account for \$196 million annually, or 26 percent of the Center's total budget.

**Table ES-1.**

2008 NASA Ames Budget:	\$751 million
NASA & Contractor employees:	2,500
Percent of Budget Spent in California:	96%



GeneSat tracking dish at Stanford University in Northern California; a collaboration between NASA Ames and Santa Clara University CREST Program





NASA Ames' Aviation System Division houses Future Flight Central, a national Air Traffic Control/Air Traffic Management (ATC/ATM) simulation facility dedicated to solving the present and emerging capacity problems of the Nation's airports

**Table ES-2.**

	Direct Benefits*	Total Economic Benefits*
Bay Area	\$523 million 3,280 jobs	\$877 million 5,306 jobs
California	\$531 million 3,377 jobs	\$932 million 5,904 jobs
United States	\$552 million 3,578 jobs	\$1.3 billion 8,423 jobs

\*Figures are annual

## Multiplier Effects of NASA Ames Spending

NASA Ames' direct expenditures result in an additional \$777 million in annual economic output as its spending ripples through the national economy. An additional \$408 million in economic output is generated within the state economy, and \$354 million within the Bay Area. In other words, each dollar spent by NASA Ames generates \$2.49 of total economic output throughout the United States, approximately \$1.78 of economic output within California, and \$1.68 in the Bay Area.

## NASA Ames' Total Economic Impact

As one of the Bay Area's most active research institutions, NASA Ames has a large impact on the regional, state, and national economies. The Center's scientific, research, and education activities result in:

- ▶ \$1.3 billion in annual economic impact for the United States, \$932 million for California, and \$877 million for the San Francisco Bay Area;
- ▶ Over 8,400 jobs in the U.S., 5,900 in California, and 5,300 in the Bay Area.



## **NASA Research Park Delivers Results**

### **NASA Research Park Profile**

In its seventh year, NASA Research Park (a major public-private partnership initiative sponsored by NASA Ames) continues to expand its impact on the regional, state, and national economy. NRP provides a nourishing and dynamic environment for cutting-edge research and education.

NASA Ames has established NRP as:

- ▶ A world-class shared-use R&D and education campus for industry, academia, nonprofits, and government;
- ▶ A center for innovation and entrepreneurship;
- ▶ A unique community of scientists, engineers, students and educators with a shared mission.

As a physical place, NRP fosters both informal and formal interactions through master planning and site planning of streets, sidewalks, and public spaces, as well as careful selection of tenants. It is widely acknowledged that innovation depends on bringing multiple disciplines together to engage in collaborative projects that often yield unpredictable, but highly productive results.

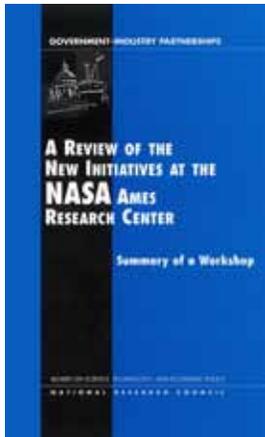
*“NASA is a tremendous environment for encouraging innovation - it’s all about solving problems that are seemingly unsolvable. After realizing that we could make oxygen on Mars, making electrons on Earth seemed far less daunting. We’re grateful to NASA for giving us a challenge with serendipitous impact for mankind.”*

*K.R. Sridhar, Founder and CEO of Bloom Energy, NRP Tenant*

### **NRP Accomplishments at a Glance:**

- ▶ *Environmentally entitled for up to 5.7 million square feet of new construction;*
- ▶ *70 on-site partners at present;*
- ▶ *675,000 square feet leased and occupied;*
- ▶ *42 acres leased to Planetary Ventures LLC to develop 1.2 million square feet office/R&D Google, Inc. campus;*
- ▶ *77 acres leased to University Associates, LLC. to develop 2.9 million square feet of office, educational, R&D, and housing;*
- ▶ *\$14 million plus lease revenue and cost reimbursement in Fiscal Year 09.*





*A Review of the New Initiatives at the NASA Ames Research Center: Summary of a Workshop*

Charles W. Wessner, Editor, Steering Committee for Government-Industry Partnership for the Development of New Technologies, Board on Science, Technology, and Economic Policy, National Research Council (2001)



*Understanding Research, Science and Technology Parks: Global Best Practices: Report of a Symposium*

Charles W. Wessner, Editor; Committee on Comparative Innovation Policy: Best Practice for the 21st Century; National Research Council (2009)

## National Research Council Reports on NRP

NRP has been the focus of intense study since its inception. The National Research Council's Science, Technology, and Economic Policy Board found that NRP represented a "new model for Industry-Government Partnerships" in its 2001 report, *A Review of the New Initiatives at NASA Ames Research Center: A Summary of a Workshop*. Eight years later, the National Research Council issued a report, *Understanding Research, Science, and Technology Parks: Global Best Practices (2009)*, citing NRP as having "made great progress, exceeding expectations and enacting NASA plans with remarkable effectiveness."

The National Research Council has noted that NRP is different from traditional science and technology parks in the following ways:

- ▶ Traditional science and technology parks are oriented toward transferring technology and knowledge out to the external community;
- ▶ NRP provides a two-direction channel focused on (i) traditional NASA technology commercialization "out" to industry, and (ii) technology infusion "into" NASA by gaining access to knowledge and leading-edge technology from the external community;
- ▶ NRP serves as NASA access to Silicon Valley and California's research universities.



### NASA Research Park Economic Benefits

NASA Research Park will build upon its current activity and generate substantial new economic activity, benefiting the nation, California, and the San Francisco Bay Area. These benefits stem from both construction spending (Table ES-3) and ongoing operations of NASA Ames’ on-site partners (Table ES-4).

### Summary of Direct NRP Construction Impacts

- ▶ Construction of NASA Research Park over its 15-year build-out period will generate slightly over \$2.4 billion in direct spending and an additional \$4.0 billion in induced and indirect spending nationally (totalling \$6.4 billion in the United States);
- ▶ For California, total construction-related economic output will top \$4.2 billion;
- ▶ In the Bay Area development at NRP will result in \$4.0 billion in economic output;
- ▶ Construction activity will generate significant employment, producing an average of over 1,000 direct jobs each year during the 15-year development period. Total construction-related employment is projected to be over 2,800 jobs nationally, 1,900+ for California, and significant local job creation, with more than 1,700 jobs in the Bay Area.

**Table ES-3.**

Direct NRP Construction Spending*:	\$2.4 billion
	1,064 jobs**
Total NRP Construction Economic Output*:	
Bay Area	\$4.0 billion
	1,737 jobs
California	\$4.2 billion
	1,916 jobs
United States	\$6.4 billion
	2,847 jobs

\*Figures calculated over 15-year build-out period

\*\*Average annual jobs



**Table ES-4.**

Total NRP Partner Spending upon Buildout*:	
	\$2.3 billion
	11,527 jobs
Total Economic Benefits of NRP Partner Spending*:	
Bay Area	\$4.0 billion
	21,384 jobs
California	\$4.2 billion
	23,576 jobs
United States:	\$5.8 billion
	33,793 jobs

\*Figures are annual

### Permanent Jobs and Economic Output at Full Operation

- ▶ When NRP is fully built out, NASA on-site industry, academic, and nonprofit partners will generate up to \$5.8 billion annually in new economic activity, creating approximately 33,800 jobs nationally;
- ▶ NRP spending in California will result in \$4.2 billion in annual economic output and 23,600 new jobs;
- ▶ The bulk of the economic gain will occur in the San Francisco Bay Area (\$4 billion in annual economic output and over 21,400 jobs).

### NRP Multiplier Effect Nationwide

Dividing each geography's total output by its direct output provides a measure of the economic activity generated throughout the U.S. economy of every dollar spent. Thus, for every dollar of economic activity from operations, NRP will generate approximately \$1.67 in annual regional economic activity, \$1.75 within the State, and \$2.42 within the nation. This level of output on a per-dollar basis is similar to that of NASA Ames as a whole.



### Total Economic Impacts of NASA Ames and NRP (2009 Annual Figures)

- ▶ Combined, NASA Ames and NRP will ultimately generate 14,800 direct jobs, representing over \$2.9 billion in annual direct spending by NASA and its on-site partners;
- ▶ Total combined annual economic activity is estimated to be \$7.1 billion nationally, generating 42,200 jobs;
- ▶ NASA Ames and NRP spending within California will result in \$5.1 billion in annual economic output, with the provision of 29,500 jobs;
- ▶ The San Francisco Bay Area will enjoy the majority of the economic impacts of NASA Ames and NRP, with \$4.9 billion in annual economic output, and 27,000 jobs generated in the region.



Unimodal Systems LLC Prototype (NRP Partner) Personal Rapid Transit (PRT) Model

**Table ES-5.**

<b>Total Direct Spending*:</b>	
	\$2.9 billion
	14,810 jobs
<b>Total NASA Ames/NRP Economic Benefits*:</b>	
Bay Area	\$4.9 billion
	26,690 jobs
California	\$5.1 billion
	29,480 jobs
United States:	\$7.1 billion
	42,216 jobs

\*Figures are annual



## Driving an Innovation-Based Economy

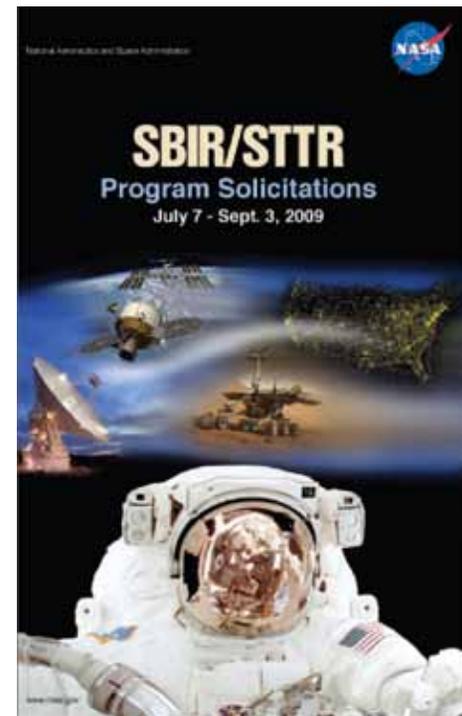
NASA Ames and the NRP community together act as a significant driver for the development of innovative new technologies. NASA Ames has often taken the lead in higher-risk, longer-term research projects, in addition to more basic research projects, contributing breakthrough results to the scientific and technological communities.

Unlike most national laboratories, NASA Ames has tended to march boldly in step with its highly innovative home region of Silicon Valley, and has helped shape the region's evolution. Advances in the unpredictable, high-risk arena of investments in scientific R&D are typically made in an incremental, additive fashion. But occasionally, a more radical breakthrough emerges—a new field is established, such as NASA Ames' path-breaking work to establish the scientific field of astrobiology.

This active participation by Ames Research Center and the establishment of NRP in the dynamic Silicon Valley “innovation ecosystem,” with its network of businesses, investors, and institutions, symbiotically supports the development of new technologies and products with national and global importance.

## Promoting Small Business Development

NASA Ames manages NASA Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. In 2009, NASA awarded a total of \$42.7 million in Phase I contracts to 362 small businesses in 36 states that funded research in such areas as minimizing safety concerns of aging aircraft, advancing new techniques for suppressing fires on spacecraft, and developing advanced technologies for deep space communications. An additional \$109.6 million was awarded in 157 separate contracts under Phase II funding programs. (Note that these Phase I and II figures are combined SBIR and STTR figures).



Small Business Innovation Research /  
Small Business Technology Transfer



## Innovative Partnerships

NASA Ames' Innovative Partnership Program (IPP), enhances NASA ability to meet mission technology goals by establishing mutually-beneficial joint collaborations with industry, other government agencies, and academia to “spin-in” and “spin-out” technologies and initiate cost-shared, joint-development partnerships. The IPP innovation fund encourages the development of novel technologies with breakthrough potential. The IPP Seed Fund provides bridge-level funding to enable larger partnerships and development efforts to occur, and encourages, to the maximum extent possible, the leveraging of funding, resources and expertise from non-NASA partners, NASA programs and projects, and NASA centers. IPP collaborations resulted in 200 Space Act Agreements in 2009, 14 licenses from 2006 to 2009, and \$21 million of funding into Ames in 2009.

## The Venture Capital Network

The Venture Capital Network connects partner venture capital firms to a group of subject-matter experts throughout NASA. In the pilot phase of the project. The subject-matter experts group, comprising scientists from eight different technology areas, “review” technology notes from member venture capital firms, and provide feedback.

The goal of this project is to connect NASA scientists, engineers, and program managers to the innovation occurring in early-stage technology startups by forging relationships with the venture capital industry that invests in these companies. NASA benefits by having access to information that would normally not be available to its personnel, and also by aligning start-up companies with NASA future technology needs and requirements.



The Lunar Crater Observation and Sensing Satellite (LCROSS) in Ames clean room N-240 - mission staff cleaning for shipment to Northrop Grumman, Redondo Beach, CA



## NASA Technology Comes to Earth

Bloom Energy can trace its roots to work performed at the University of Arizona as part of the NASA Mars space program. Dr. KR Sridhar and his team were charged with creating a technology that could sustain life on Mars. They built a device capable of producing air and fuel from electricity, and/or electricity from air and fuel.

They soon realized that their technology could have an even greater impact here on Earth.

In 2001, when their project ended, the team decided to continue their research and start a company. Originally called Ion America, Bloom Energy, was founded with the mission to make clean, reliable energy affordable for everyone on earth.

In 2002, John Doerr, and Kleiner Perkins became the first investors in the company. Kleiner Perkins was legendary for its early backing of other industry changing companies, like Google, Amazon.com, Netscape, and Genentech, but Bloom was its first clean tech investment. In fact, at that time, clean tech was not even really a word.

With financing in place, the team packed three U-hauls and headed to NASA Ames Research Center in Silicon Valley to set up shop. Over the next few years, the technology quickly developed from concept, to prototype, to product, as the major technological challenges were solved and the systems became more powerful, more efficient, more reliable, and more economical.

In early 2006 Bloom shipped its first 5kW field trial unit to the University of Tennessee, Chattanooga. After two years of successful field trials in Tennessee, California, and Alaska, to validate the technology, the first commercial (100kW) products were shipped to Google in July 2008.

Since that time Bloom's Energy Servers have helped our customers generate millions of kWhs of electricity and eliminate millions of pounds of CO2 from the environment.

From humble beginnings on Mars, Bloom Energy is now changing the Earth for the better.

Source: <http://bloomenergy.com/about/company-history/>

## Green/Clean Technology Initiatives

NASA Ames actively supports Silicon Valley's and California's leadership in the rapidly evolving and expanding Green/Clean technology sectors. The Center pursues a diverse portfolio of partnerships with both large and emerging enterprises focused on:

- ▶ Global monitoring and prediction;
- ▶ Clean energy;
- ▶ Sustainable systems;
- ▶ Green aviation.

These "green" partnerships both advance NASA mission and generate new technologies and products for worldwide use. Examples include applying planetary imaging to enzyme screening, using sensor network technology to generate environmental data and monitor water distribution systems, developing microspheres to transform paint and roofing materials into energy-saving sources of insulation, designing greener aircraft, and formulating environmentally friendly anti-icing fluid to keep hazardous ice from building up on airplane wings. Through these innovative projects, NASA Ames plays a key role creating jobs in the private sector.



## Commercial Space Industry

The Ames Space Portal has been a catalyst for the growth of commercial space and space entrepreneurship. NASA Ames' "NOT business-as-usual" approach is the cornerstone to building a space economy and new jobs.

The Space Portal at NASA Ames provides a "friendly front door" for companies and organizations outside NASA to work with the Agency. The Space Portal facilitates commercial access to government expertise and facilities; provides analyses of future trends and opportunities to senior decision-makers; builds alliances among suppliers of commercial space services, potential customers, and interested investors; and promotes space projects for humanitarian benefits, education, and commerce. The Space Portal's successes include:

- ▶ Commercial Orbital Transportation Services Program (COTS) in partnership with NASA Johnson Space Center;
- ▶ Centennial Challenges Program for aerospace research and development;
- ▶ Commercial Re-usable Sub-orbital Research (CRuSR) Program that provides NASA and other researchers access to commercially-developed sub-orbital spacecraft;
- ▶ Promoting the space environment for bioscience research.



Commercial Orbital Transportation Services Program (COTS). Illustration of Low Earth Orbit spacecraft provided by Silicon Valley Space Club

*“Carnegie Mellon’s tradition of innovation is clearly legendary. Carnegie Mellon is a cherished asset for both Silicon Valley and the entire technology community.”*

*Dr. Eric Schmidt, CEO, Google*



NRP-based Carnegie Mellon Innovations Lab (CMIL) development of MAX prototype rovers; expedition photo taken in the Atacama Desert, the driest place on Earth. Virtually sterile, the desert serves as an analog for Mars’ environment. This program is an example of STEM post-secondary education and research opportunities

## **Advancing STEM Education**

Without question, science, technology, engineering, and math (STEM) education is the key to keeping America’s economy growing in an increasingly competitive global economy. NASA Ames is a key resource to advance our nation’s goals to promote STEM education and provide a highly trained workforce for the future. In addition, NASA must inspire America’s younger generation if the Agency is to maintain the high quality of its own workforce.

NASA Ames delivers a wide variety of STEM programs addressing K-12 as well as post-secondary education.

- ▶ At the primary and secondary level, NASA Ames operates, sponsors, or is a partner in ten programs, including Ames Exploration Encounter, Ames’ Educator Resource Center, robotics competitions, and hands-on science events;
- ▶ At the post-secondary education level, the Center offers an impressive array of STEM education and research opportunities through eighteen programs, not including on-site degree and/or certification programs offered by the University of California, Santa Cruz, Carnegie Mellon University, and Singularity University;
- ▶ To address the underrepresentation of minorities in STEM fields, NASA Ames established a highly successful on-site partnership with the United Negro College Fund (UNCF) Special Programs Corporation. This program has expanded to the Johnson Space Center in Texas and Glenn Research Center in Ohio.

## ***Supporting Regional Community Resources and Economic Development***

NASA is a powerful brand and its name and logo are recognized around the world. Through ongoing activities at NASA Ames and NRP, the Agency boosts the profiles of local communities, which assists local economic development professionals in retaining and attracting businesses to the area. Tenants that have outgrown NRP have relocated to spaces in neighboring Mountain View and Sunnyvale.

By partnering with world-class research universities and establishing on-site education and research programs, NASA Ames creates a critical mass of students, faculty, and researchers that forms a unique community and an outstanding pool of talent that is highly attractive to business.

Through its support and cooperation, NASA Ames helps preserve and protect sensitive natural resources such as bay wetlands and burrowing owl habitat, as well as provide enhanced recreational opportunities by extending the San Francisco Bay Trail through the Center. All these contributions strengthen the Bay Area's overall quality of life.



Sunnyvale-based Bloom Energy started in NRP and still maintains an on-site R&D facility at NASA Research Park

*“In the 21st Century, America’s communities will derive economic strength by acting regionally to compete globally. Innovation and entrepreneurship are the new engines of job creation, productivity, growth, economic prosperity, and healthy communities.”*

*Strengthening America’s Communities Advisory Committee  
(U.S. Department of Commerce, July 1995  
<http://www.eda.gov/PDF/EDAmericaSummer05.pdf>)*





NASA Ames celebrates its 70th anniversary on August 5th, 2009

## **Conclusion**

After 70 years of innovation, NASA Ames will pursue in the coming decades new scientific advances, breakthrough technologies, and STEM education. As a NASA field center with a unique location in Silicon Valley and an organizational culture open to change, experimentation and partnerships, NASA Ames creates jobs locally, regionally, statewide, and nationally. As our national economy continues to undergo a transformation into a knowledge-based economy, NASA Ames will contribute to national prosperity through its initiatives in green/clean technology, the commercialization of space, and the development of NASA Research Park.

This economic benefits study presents an in-depth report of NASA Ames' many programs, initiatives, and other activities that generate positive economic impacts for the region, state, and nation. This study was prepared by Bay Area Economics, a national urban economics consultancy based in Emeryville, CA.



***PART I:***  
INTRODUCTION





## Part I: Introduction

NASA Ames Research Center (NASA Ames), one of ten NASA Centers throughout the country, is located in Northern California's iconic Silicon Valley. Over the past several years, NASA Ames has transformed itself into a forward-looking research organization that is innovative, eager to partner with the private sector and universities, and committed to environmental sustainability—all for the purpose of advancing NASA mission and meeting our nation's challenges.

To complete this radical transformation, NASA Ames initiated a series of bold steps and utilized public-private partnerships to complement and support its traditional program activities. Its NASA Research Park (NRP) program has established the Center to wide acclaim as a national collaborative campus for basic scientific research, technology development, and education in science, technology, engineering and mathematics. This transformation has enabled NASA Ames to build research and technology development partnerships with numerous private technology firms and prestigious academic institutions and attract new resources to the Center.

The continuing operation of NASA Ames and the implementation of the Center's strategic initiatives (such as NRP) will provide significant positive economic benefits to the San Francisco Bay Area, California, and the nation for decades to come, amplifying the excellence and benefits that it provides.

*“For our communities and for our country to thrive in this new century, we need to harness the spirit of innovation and discovery that has always moved America forward. We must foster innovation that will lead to the technology of the future... that will in turn lead to the industries and jobs of the future.”*

*President Barack Obama, August 2009*



*Ames was the second of NASA 10 field centers, founded in 1939 as an aeronautics research laboratory. It became part of NASA in 1958. Ames is named for Dr. Joseph S. Ames, former chair of the National Advisory Committee for Aeronautics.*

## **Approach**

This study quantifies the overall economic benefits of NASA Ames and NRP, providing a description of how the Center and NRP spur economic development, stimulate technology, promote innovation, and support science education regionally and throughout the country. To quantify economic benefits, this study uses the widely accepted IMPLAN (IMPact analysis for PLANning) input-output model developed by the University of Minnesota. The IMPLAN model takes customized inputs of employment and expenditures and estimates direct, indirect, and induced employment and economic activity. A detailed description of IMPLAN and the study methodology is presented in Appendix A.



## Study Organization

This study is organized as follows:

- ▶ **Executive Summary:** Overview of Findings;
- ▶ **Part I: Introduction;**
- ▶ **Part II: Ames Stimulates the Economy.** This chapter presents a description of the myriad ways NASA Ames spurs national technological innovation, fosters workforce development and drives the regional economy, and includes a quantified estimate of the economic stimulus achieved by its employment and economic activity;
- ▶ **Part III: NASA Research Park Delivers Results.** This chapter focuses on the NASA Research Park, including a description of current partnerships and future development plans, as well as a quantification of NRP's economic benefits;
- ▶ **Part IV: Ames + NRP Drive Regional Economic Development.** The final chapter focuses on the combined effects of Ames and NRP on regional and local economic development;
- ▶ **Appendices:**
  - Appendix A: IMPLAN Background and Methodology
  - Appendix B: Science, Technology, Engineering, and Math Education Programs at NASA Ames
  - Appendix C: IMPLAN Analysis Assumptions

Project appendices can be downloaded at <http://researchpark.arc.nasa.gov/Public/publicDocs.html>

In addition to these sections, "Spotlights" are included throughout the document. Spotlights are case studies that provide examples of current projects and initiatives underway at NASA Ames that illustrate how technology is being used to address a range of challenges and opportunities.



Aerial imagery of NASA Ames Research Center

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***PART II:***  
**AMES STIMULATES THE ECONOMY**





## Part II: Ames Stimulates the Economy

Part II presents an overview of NASA Ames, including its mission, expenditures, and employment characteristics. Specifically, Part II outlines NASA Ames' role in contributing to innovations in science and technology (including examples of projects and initiatives that drive advancements), support of local and regional business development, and STEM education programs.

This section also provides an analysis of the quantified economic benefits of NASA Ames on the regional, state, and national economies.

### Overview of Ames Research Center

As one of 10 NASA field centers nationwide, NASA Ames provides the technologies, products, and services that enable America's space and aeronautics programs.<sup>1</sup> From small spacecraft to supercomputers, science missions and payloads to thermal protection systems, information technology to aerospace, NASA Ames plays a critical role in virtually all NASA missions.

With an overall budget of \$751 million in Fiscal Year 2008, NASA Ames Research Center employs approximately 1,300 civil servants and 1,200 contractor employees. Ames provides leadership in supercomputing, astrobiology, atmospheric, biospheric, and airborne sciences; intelligent/adaptive systems, robotics, small satellite rocket technologies, and advanced thermal protection. Ames also provides innovation in fundamental space biology, biotechnology and human factors research.

<sup>1</sup> For more information regarding NASA AMES, see "NASAFacts" (May 1, 2009) available at [www.nasa.gov](http://www.nasa.gov), and the NASA AMES website at [www.nasa.gov/centers/ames/home/index.html](http://www.nasa.gov/centers/ames/home/index.html)

*"The Federal Government should take advantage of the expertise and insight of people both inside and outside the Federal Government, use high-risk, high-reward policy tools such as prizes and challenges to solve tough problems, support broad based adoption of community solutions that work, and for high-impact collaborations with researchers, the private sector, and civil society."*

*President's Strategy for American Innovation*





Kepler spacecraft photometer monitors 100,000 stars to detect earth-sized planets in habitable zones

NASA programs for which NASA Ames has primary responsibility include:

- ▶ Stratospheric Observatory for Infrared Astronomy (SOFIA);
- ▶ Lunar Crater Observation and Sensing Satellite (LCROSS);
- ▶ NextGen Airspace Project;
- ▶ Kepler Spacecraft Photometer;
- ▶ Small Satellite Missions;
- ▶ Lunar Atmosphere and Dust Environment Explorer;
- ▶ High-End Computing;
- ▶ NASA Lunar Science Institute;
- ▶ NASA Advanced Thermal Protection Systems and Testing;
- ▶ NASA Astrobiology Institute.

Some recent NASA Ames ground-breaking space missions include GeneSat-1 and associated small spacecraft missions; Lunar Crater Observation and Sensing Satellite (LCROSS) include confirming the presence or absence of water ice in a permanently shadowed crater at the Moon's South Pole; and Kepler, which searches for planets in habitable zones beyond our solar system.

### ***NASA Ames Location***

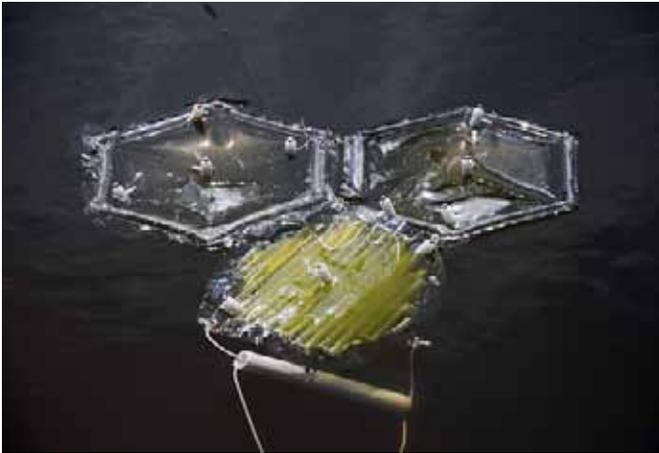
NASA Ames is located in the heart of Silicon Valley, adjacent to the cities of Sunnyvale and Mountain View, California. The Center occupies a total of 2,000 acres, with direct access via two freeway exits from Highway 101. The Center is approximately 11 miles from downtown San Jose, and 36 miles from San Francisco.

Ames' location in Silicon Valley shapes the core of its role in the national and local economy. With a strong emphasis on creating collaborative partnerships with other NASA centers and local Silicon Valley organizations, companies, and academic institutions, Ames has become a major node in the innovation economy characterizing Silicon Valley. These partnerships with Silicon Valley innovators, and Ames' leadership role, in turn drive ground-breaking commercial innovation and technological development benefiting the nation's economy.





Figure II-I. NASA AMES Location and partners - Image courtesy of Silicon Valley Map & Calendar published in partnership with Silicon Maps, Inc. and Trestria - www.siliconvalleymap.com



OMEGA ('Offshore Membrane Enclosure for Growing Algae') is a potential source of biodiesel

## ***Leading-Edge Research Stimulates Science and Technology***

NASA Ames' role in the regional, state, and national economy goes far beyond the dollars it generates and the jobs it supports. As a national research asset, NASA Ames has often taken the lead in higher-risk, longer-term, or more basic research projects, contributing breakthrough results to the scientific and technological communities. Indeed, unlike most national laboratories, NASA Ames has tended to march boldly in step with its highly innovative home region of Silicon Valley, and helped shape the region's evolution. Advances in the unpredictable, high-risk arena of investments in scientific R&D are typically made in an incremental, additive fashion. But, occasionally a more radical breakthrough emerges—a new field is established, such as NASA Ames' path-breaking work to establish the scientific field of astrobiology. This active participation by NASA Ames in the dynamic Silicon Valley "innovation ecosystem," with its network of businesses investors and institutions, symbiotically supports the development of new technologies and products with national and global importance.



Silicon Valley is rightly touted worldwide as a region of entrepreneurial and technological excellence, with a 40-year record of performance and success. The region has weathered numerous economic downturns, each time to return revitalized and stronger than before. Many academic studies have confirmed Silicon Valley to be the most diverse technology region in the United States, with scholars concluding that the region is unique for its “recipe” of putting all the necessary ingredients together to create an economic powerhouse.

Figure II-2 indicates the evolution of the Silicon Valley economy and how NASA Ames has played a critical role in shaping the course of the region’s growth over seven decades. Starting with contributions in the aerospace and defense sectors in the 1930’s through the 1950’s up to the latest wave of Web 2.0 and Green/Clean-technology related growth in early years of the 21st century, NASA Ames has made, and continues to make, important contributions.

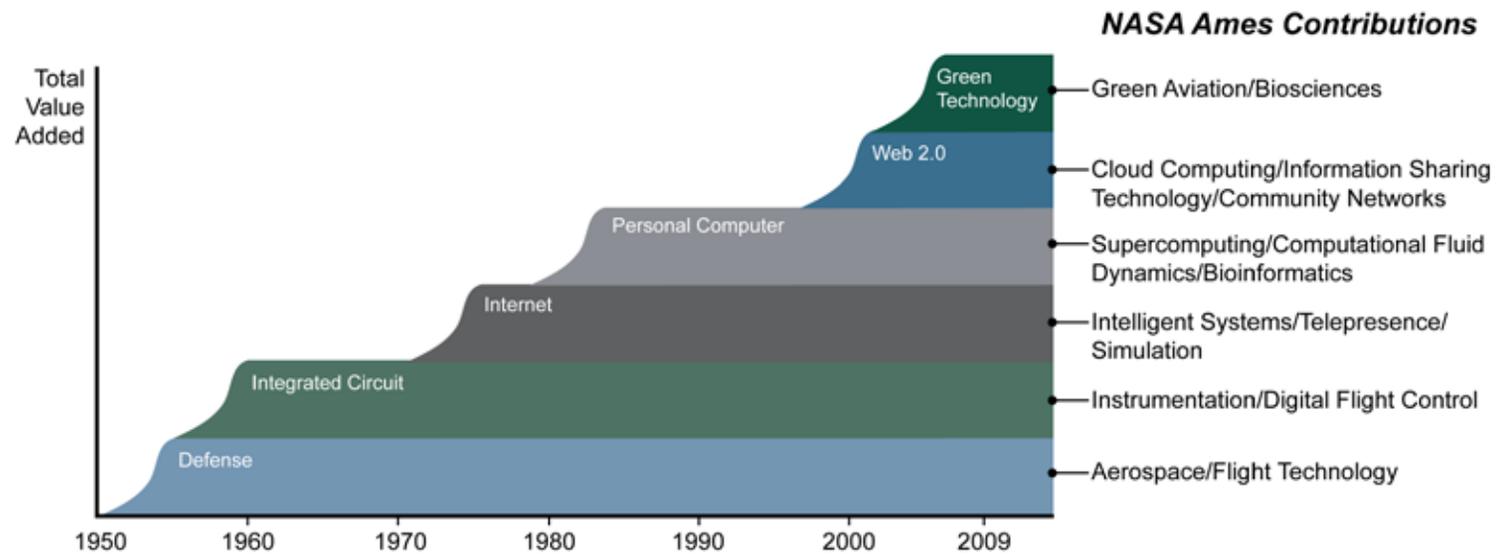


Figure II-2. NASA Ames R&D Contributes to Silicon Valley Evolution





North American XP-51B Airplane with outer wing panels removed and ready for testing in Ames 16-foot wind tunnel

Throughout these eras, NASA Ames scientists and engineers made significant contributions to military and commercial programs. In the 1940s, for example, NASA Ames scientists used their state-of-the-art wind tunnels to perfect new aircraft such as the XP-51B, the experimental predecessor to the P-51 Mustang. In the 1970s, NASA Ames and Stanford University collaborated on ways to miniaturize biological research instruments for the Viking mission to Mars. Their discoveries resulted in two devices—the microminiaturized acceleration sensor and the super-miniaturized gas chromatograph ensemble—that established today's \$5 billion MEMS (micro-electro-mechanical systems) industry. In 2005, NASA Ames provided both leadership and support to the California Blue Ribbon Task Force on Nanotechnology to establish Silicon Valley as a center for nanotechnology. More recently, NASA is working with Cisco Systems Inc. to develop an online collaborative global monitoring platform called “Planetary Skin” to assist in monitoring environmental conditions around the world.

The following sections provide a more detailed profile of the patents, licenses, business development, commercialization projects, and other ways which NASA Ames has stimulated science and technology, benefiting the economy.



**1940**  
Conical Camber

**1950**  
Arcjet Research

**1960**  
Swept-Back/Wing  
Apollo Re-Entry Shape

**1970**  
CFD  
Hypervelocity Free Flight

**1980**  
Air Transportation System

**1990**  
Nanotechnology

**2000**  
Human Centered Computing

**2010**  
NASA Lunar Science Institute

**Other Innovations:**  
 - Tektites  
 - Flight Simulator  
 - Blunt Body Concept  
 - Transonic Flow  
 - Lifting Body  
 - Apollo Heat Shield Tests  
 - Apollo Guidance System  
 - Pioneer  
 - X-36  
 - Galileo  
 - Lunar Prospector  
 - Viking  
 - Pioneer Venus  
 - Tiltrotor  
 - Kuiper Observatory  
 - ER-2  
 - NASA Research Park  
 - Kepler  
 - LCROSS  
 - LADEE  
 - One of the World's Fastest Operational Supercomputers



***Spotlight on the NASA Astrobiology Institute:  
Creating community around the globe to tackle life's big questions***

The NASA Astrobiology Institute (NAI) was founded in 1998 as part of NASA long-term quest to address astrobiology's fundamental questions: How does life begin and evolve? Is there life elsewhere in the universe? What is the future of life on Earth and beyond?



The NAI is a non-traditional "institute without walls," with a total of ~600 researchers in fourteen competitively-selected teams across the United States and international partnerships with astrobiology organizations in Spain, Australia, Britain, France, Russia, and with a European consortium. A small management office at Ames Research Center administers the Institute, providing leadership to make the whole more than the sum of its parts.

The great management challenge of astrobiology is bringing together the many diverse disciplines in the geological, biological, and astronomical sciences that all have "a piece of the puzzle." The NAI has developed a wide variety of approaches to interlacing interdisciplinary efforts into "big picture" endeavors. A crucial element is innovative use of information technologies that enable scientific collaboration over distance and make possible broad involvement of the world's experts in astrobiology.

The NAI also plays key roles in shaping NASA space missions, nourishing public interest in astrobiology through a strong education and public outreach program, and cultivating new generations of astrobiologists.

Website: <http://astrobiology.nasa.gov/nai>



*NAI technologies bring researchers together from around the world*



## NASA Lunar Science Institute



The NASA Lunar Science Institute (NLSI) opened its doors in April 2008, modeled after the successful NASA Astrobiology Institute and its virtual institute business model. It quickly became a major part of a worldwide renaissance in lunar science and exploration, and hosted the largest Moon-focused

conference in decades at Ames in July 2008, drawing scientists from all over the United States and world.

The NLSI selected its initial seven competed domestic teams in January 2009, each comprising multiple research institutions including universities, NASA field centers and industry. With these teams, the NLSI has both a broad and deep scientific base ranging from studying use of the Moon as a window to the early universe to advanced lunar modeling and sample analysis. With countries beyond the U.S. returning to the Moon, the NLSI has engaged a growing number of international partners ranging from Canada and the United Kingdom to South Korea, Saudi Arabia and Israel, and has begun starting regional partnerships around the globe.

The business of a virtual institute relies on technologies to bring geographically diverse teams together. The NLSI and NASA Astrobiology Institute both partner with the world-leading Cal IT2 organization at U.C. San Diego, which develops new approaches in visualization technologies; from this partnership NLSI has begun use of hyperwall displays to allow investigators to work together simultaneously on the very large images and datasets being brought back by the current generation of lunar missions. Additionally, NLSI was a founding sponsor of the Center for Collaboration Science and Applications, a partnership between NASA, Carnegie Mellon University and Lockheed Martin located in the NASA Research Park.

The NLSI sponsors a wide range of activities to elevate the lunar science community and train the next generation of lunar scientists. The Lunar Orbiter Image Recovery Project, sponsored by NLSI, obtained international attention for its meticulous effort to read very old magnetic tapes of data obtained by the Apollo-era Lunar Orbiters; images obtained from this project (including the first-ever image of the Earth taken from beyond Earth orbit) are far better than the original images and are proving invaluable to the scientific community. The NLSI also played a major role in the Lunar Regolith Challenge, part of the Centennial Challenges program; the testbed used for this challenge is now part of an international program allowing students of all ages to operate robots remotely.

Website: <http://lunarscience.arc.nasa.gov/>





Ames Mars Wind Tunnel Facility; NASA Simulation of Small Martian 'Dust Devils'

## Patents and Licenses Spark Innovation

One of NASA Ames' approaches to managing its intellectual property (IP) is through patents and licenses to "spin-out" technology (as mandated under the Space Act of 1958), creating new business opportunities and attracting private sector partners to work alongside of NASA to their mutual benefit. From the industry perspective, collaborating with NASA Ames often results in lowered technology development costs and/or reduced time to develop required technologies and new innovations. From the NASA side, these collaborations and technology transfer activities not only generate a stream of revenues for the Center but also improve the quality of life for all Americans, fulfilling the intent of the Space Act.

**Table II-1.** Patent Activity at NASA Ames Research Center, 2004-2009

Year	Filed	Issued	All Active Patents
2004	13	8	66
2005	13	11	69
2006	20	6	64
2007	12	12	64
2008	6	1	72
2009	9	14	86
Total	64	48	

Sources: NASA Ames Technology Partnership Division, 2009; Bay Area Economics, 2009



## Patent and License Activity

Since 2004, NASA Ames has filed 64 new patents and has received 48. Cumulatively, there are 335 currently active patents at NASA Ames. Table II-1 illustrates patent applications filed between 2004 and 2009, as well as the total number of patents held by the Center. Table II-2 lists NASA Ames patent application filings from 2006 to 2008, illustrating the diverse range of industry, activity, and innovation occurring at NASA Ames.

NASA also has the authority to grant licenses for its domestic and foreign patents and patent applications. All NASA licenses are individually negotiated with the prospective licensee, and each license contains terms concerning commercialization (practical application), license duration, royalties, and periodic reporting. Table II-3 presents a summary of recent licensing activity.

NASA Ames' robust technology transfer program fuels innovation. The scientific and technological advances represented by the Center's patents and licenses add to our nation's knowledge base and generate new technologies, products and services, companies, markets, and even entirely new industries.



License of rehydration formula for astronauts resulting in wellness products for athletes

**Table II-2.** Recent NASA Ames Patent Applications, 2006-2008**2006 (Filed)**

Low Cost Portable Planetarium Imaging System

Finite-Difference Simulation and Visualization of Elastodynamics in Time-Evolving Generalized Curvilinear Coordinates

Selective Functionalization of Carbon Nanotubes Based upon Distance Traveled

Light Collimator and Monitor

Compensation for Thermal Expansion Differences and Thermal Shock Effects in a Thermal Protection System

Coated or Doped Carbon Nanotube Network Sensors as Affected by Environmental Parameters and Elapsed Time

Interactive Inventory Monitoring

Control of Chirality and Other Structural Characteristics in Nanostructure Growth

Resistive Switching Memory Using Low-Dimensional Phase-Change Material as Programmable Element

Carbon Nanotube Growth Density Control

Determination and Application of Location and Angular Orientation of a Pill Transmitter

Nanotechnology Sensors for Determination of Chemical Substances in an Oil Reservoir

Context Based Configuration Management Concept

Growth Method for Phase Change Nanostructures

Wet Waste Drying Bag

Expendable Waste Compacting Dryer

Visual Signal Sensor Organ Replacement: Implementation

Toughened Uni-piece Fibrous Reinforced Oxidation-Resistant Composite (TUFROC)

Water Treatment Systems for Long Space Flight Use

Detection of Presence of Chemical Precursors

Dielectrophoresis-Based Particle Sensor Using Nanoelectrode Arrays

Dielectrophoresis Based On-chip Particle Concentrator Using Carbon Nanotube Electrode Arrays

**2007 (Filed)**

A Versatile Platform for Nanotechnology Platform Based on Modifications of a Chaperonin Protein

Wireless Chemical Sensor Data Transmission System Based on Nanotechnology

Controlled Nanostructure Sensing and Transmission of Gas Data

Increased Alignment in Carbon Nanotube Growth

Cellulose Dissociation Using Selected Chaperonin Molecules

A Hybrid Direct-Indirect Adaptive Control Method for Flight Vehicles

Nonengineered Thermal Materials Based on Carbon Nanotube Array Composites

A Proposal for Gene Synthesis

Pyrotechnic Rotary Valve Actuator

In-situ Formation of Reinforcement Phases in Ceramic Composites and Ultra High Temperature Ceramic Composites for Advanced TPS Applications

Nanotechnology Sensor of Presence and Concentration of a Target Molecule

A Method to Measure the Recession of Ablative Materials in Arc-Jet Testing Using Digital Stereo-photogrammetry and Image Cross-Correlation

**2008 (Filed)**

Artificial Immune System Based Approach for Air Combat Maneuvering

Improved Solar Cell Efficiency Using Nano-Sculpted Substrate

Atmospheric Entry Heat Shield Employing Cured Thermal Protection Material Blocks Bonded in a Large-Cell Honeycomb Matrix

Enhanced Project Management Tool

Radiation Shielding System Using a Composite of Hydrogen-Rich Polymers Loaded with Carbon Nanotubes

Offshore Membrane Enclosures for Dewatering Algae (OMEDA)

*Sources: NASA Ames Technology Partnerships Division, 2009; Bay Area Economics, 2009.*



**Table II-3.** Licensing Activity at NASA Ames Research Center, 2003-2008

Technology	Effective	Licensee
Perilog	2003	Audition For Hollywood
NETMARK	2003	Black Tulip Systems
Real-Time Surface Traffic Adviser	2003	Intellimotion Systems Corporation
Exploring Aeronautics Multimedia CD-ROM	2003	Maecker And Company
Mars Pathfinder Stereo Pipeline	2003	Common Point, Inc.
NETMARK	2004	Xerox Corporation
ADIS and Morning Report	2004	SAGEM Avionics, Inc.
Nanoconduction Exclusive License for Carbon Nanotube Interconnects	2004	Nanoconduction, Inc.
Joint Licensing Agreement Between NASA ARC and Eloret Corporation	2004	Eloret Corporation
Air Traffic Management Evaluation Tool (FACET)	2005	Flight Explorer
Powder Handling Device for Analytical Instruments—Prototype License	2005	InXitu
Environmentally Friendly Anti Icing Fluid	2005	Appearance Products LLC
Inductive Monitoring System	2005	InStep Software, LLC
Inductive Monitoring System	2006	ISagacity, Inc
NETMARK, PMT, & Query Based Document Management	2006	Jump Start Solutions, LLC
NETMARK, PMT, & Query Based Document Management	2006	NXAR LLC
Image Data Compression Having Minimum Perceptual Error (DC Tune)	2007	Hillcrest Laboratories, Inc.
Spatial Standard Observer (SSO)	2007	TTLA Research Alliance
Biochemical Sensors Using Carbon Nanotube Arrays	2007	Early Warning, Inc.
Spatial Standard Observer (SSO)	2007	Radiant Imaging
Visual Signal Sensor Organ Replacement & Visual Image Sensor Organ Replacement	2008	Mission Critical Technologies, Inc.

*Sources: NASA Ames Technology Partnerships Division, 2009; Bay Area Economics 2009.*



**Table II-4.** Major NASA Ames Contractors, FY 2008

Contractor	Amount Awarded
QSS Group Inc.	\$46,460,869
Jacobs Technology Inc.	\$31,111,847
Computer Sciences Corp.	\$29,482,239
Universities Space Research Association	\$19,734,183
University of California Santa Cruz	\$17,175,059
IAP World Services Inc.	\$16,560,606
Northrop Grumman Space & Mission Systems	\$15,305,590
Eloret Corp.	\$12,670,325
Silicon Graphics Inc.	\$12,441,082
Sensis Corp.	\$12,431,703
DMJM/AECOM	\$12,339,733
Science Applications International Corp.	\$11,837,867
Planners Collaborative Inc.	\$9,932,335
Lockheed Martin Space Ops	\$9,577,083
Sectek, Inc.	\$9,563,098
Lockheed Martin Government Services Inc.	\$9,503,516
Dell Perot Systems Government Services	\$7,578,928
Textron Systems Corp.	\$6,994,490
Wackenhut Services Inc.	\$6,625,772
Agbayani Construction Corp.	\$6,507,363
<b>Total</b>	<b>\$303,833,687</b>

Sources: NASA Ames Research Center, 2009; Bay Area Economics, 2009

## ***Business Development Activity Supported by NASA Ames***

NASA Ames supports private sector economic activity in a number of ways, including investing in technologies that improve products and processes for the business community, providing a significant amount of contracts and grant awards, and directly supporting small businesses through targeted funding opportunities.

### **Investment and Contracts Enhance Regional Businesses**

Through its large proportion of local purchases of goods and services, grant awards, and technology collaborations, NASA Ames enhances our nation's competitiveness by investing in the development of enabling technologies that improve products or processes. NASA Ames awards, whether contracts or grants, are important mechanisms for leveraging external resources. Twenty major on-site contracting firms, each with contracts exceeding \$5 million, collectively provided \$303.8 million in services to NASA Ames in Fiscal Year 2008 (see Table II-4).

With NASA Ames acting as the "lead customer" demanding and contributing to the development of emerging technologies, the Center's contracting activity has a profound impact on the evolution and pace of innovation within Silicon Valley. Over the last 21 years, for example, NASA Ames' lead role as NASA supercomputing center led to a long-standing collaboration with Silicon Graphics Inc. and the development of a wide range of innovative computing devices including "graphics on a chip," high-end scientific workstations, single system image architecture, and shared memory.



### Small Business Development

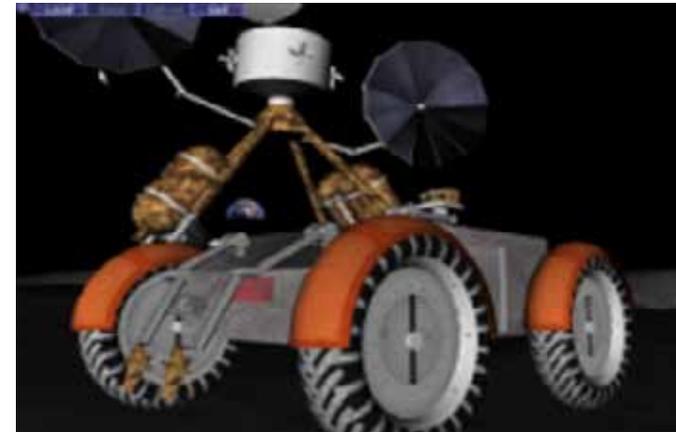
Small businesses not only generate most jobs in our country, but also are often at the forefront of technological change. NASA Ames operates programs specifically targeted to support small businesses across the nation:

- ▶ Section 8 Small Business Set-Aside Program;
- ▶ Small Business Innovation Research (SBIR) Program;
- ▶ Small Business Technology Transfer (STTR) Program.

While the Section 8 program helps small businesses in a wide variety of sectors, the SBIR and STTR programs provide an opportunity for small, high-technology companies and research institutions to participate in federally sponsored research and development efforts in key technology areas. Small businesses with 500 or fewer employees, or a non-profit research institution, such as a university or a research laboratory with ties to a small business concern, can receive significant sources of seed funding for the development of innovative technology.

The SBIR Phase I contracts last for six months with a maximum funding of \$100,000. SBIR Phase II contracts last for 24 months with a maximum funding of \$600,000. The STTR Phase I contracts last for 12 months with a maximum funding of \$100,000. STTR Phase II contracts last for 24 months with a maximum contract value that has been increased from \$500,000 to \$600,000.

In 2009, NASA funded Phase I Proposals submitted by 362 small businesses for a cumulative total of \$42.7 million and Phase II Proposals submitted by 157 entities for cumulative total of \$109.6 million.



SBIR - Lunar Telerobotics Design Simulation, DigitalSpace Corporation: Rover and Lander Concept for RLEP2 Simulated in Digital Spaces Open Source 3D Platform



SBIR - Future NAS Flight Demand Generation Tool, Sensis Corporation: Prototype system, system output and health prediction



*“Innovation is often surprising and unexpected because the process by which new ideas emerge is serendipitous and interactive...Interlocking threads of ideas, people and events are woven into a web of knowledge and -bingo- we get today’s world of science and technology.”*

*James Burke, Science historian and founder, The KnowledgeWeb Project*

*Innovative Partnership Program (IPP) collaborations have resulted in \$21 million of funding for NASA Ames in 2009.*

## ***Innovative Partnership and Seed Fund Programs Spur Collaboration***

NASA Ames’ Innovative Partnership Program (IPP), enhances NASA ability to meet mission technology goals by establishing mutually-beneficial joint collaborations with industry, other government agencies, and academia to “spin-in” and “spin-out” technologies, and initiate cost-shared, joint-development partnerships. The IPP innovation fund encourages development of novel technologies with breakthrough potential. The IPP Seed Fund provides bridge-level funding to enable larger partnerships and development efforts to occur and encourages, to the maximum extent possible, the leveraging of funding, resources and expertise from non-NASA partners, NASA programs and projects, and NASA centers. IPP collaborations resulted in 200 Space Act Agreements in 2009, 14 licenses from 2006 to 2009, and \$21 million of funding into Ames in 2009.

The IPP Seed Fund goals include providing for an increased range of technology solutions for the mission directorates, a broadened technology portfolio, improved cost avoidance for NASA, as well as accelerated development and maturation of technology and a larger pool of qualified commercial providers.

Ames has been very successful in “winning” more than the Agency-wide average number projects funded by IPP. In Fiscal Year 2006, Ames was funded for five projects for a total of \$1.3 million of IPP funding and \$4.3 million of in-kind cost contribution from its Partners. In Fiscal Year 2007, Ames was funded for six projects for a total of \$1.5 million in IPP funding and \$2.2 million of in-kind cost contribution from its Partners. The Partners include General Dynamics, Boeing, Northrop Grumman, Carnegie Mellon University, MIT, University of California, Alliance Space Systems, Lockheed Martin, Subaru Telescope, Utah State University, Ball Aerospace and Technologies, Cisco Systems, and others.

IPP collaborations resulted in 200 Space Act Agreements in 2009, 14 licenses from 2006 to 2009, and \$21 million of funding into Ames in 2009.



### The Venture Capital Network

The Venture Capital Network project connects partner venture capital firms to a group of subject-matter experts throughout NASA. The subject-matter experts group, comprising scientists, engineers, and program managers from eight different technology areas “review” technology notes from three venture capital firms in the pilot phase of the project and provide feedback.

The goal of this project is to connect NASA scientists, engineers, and program managers with the innovation taking place in early-stage technology startups by forging relationships with the venture capital industry that invests in these companies. These early-stage startups do not usually publish their research and may not be likely to interact with NASA via the SBIR/STTR Program. The venture capital firms benefit by receiving feedback on their prospective deals from NASA, and by better understanding how some of these technologies fit into the Agency’s long-term objectives. NASA gains by having access to information that would normally not be available to its personnel and by also potentially aligning the start-up companies with NASA future technology needs and requirements. In addition, collaborations and partnerships may also result from the initial exchange of information between the venture capital community and NASA.

*Silicon Valley is the nation’s hotbed of new technology enterprises. In 2009, Silicon Valley accounted for nearly 40 percent of total U.S. venture capital investment.*

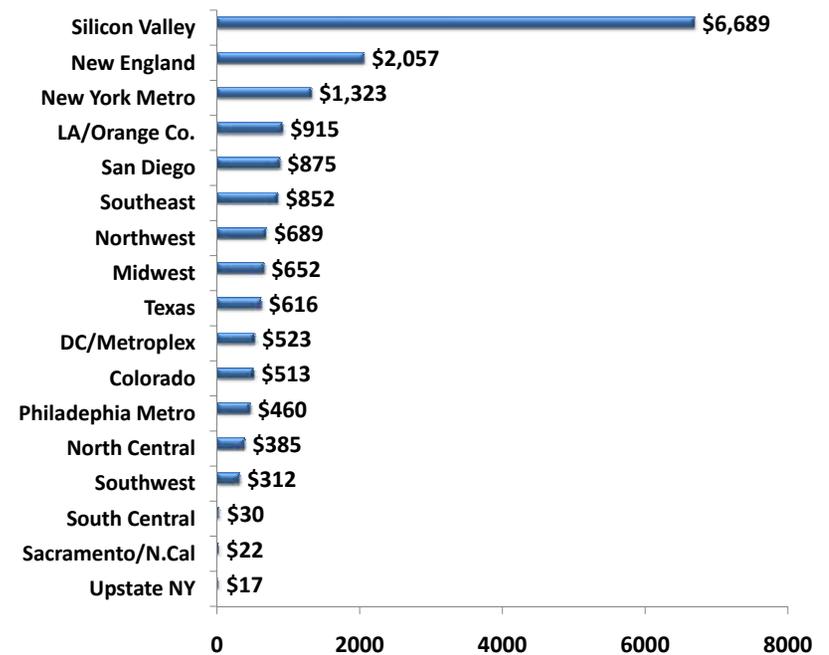


Figure II-3. 2009 Venture Capital funding by region (in millions)



### ***Google, Inc.: Turning Data and Technology into Commercial Products***

NASA and Google Inc. have delivered real results from their many collaborations since signing their first Space Act Agreement in the fall of 2006. The fruits of their labors have resulted in collaborations with partners both inside and outside of NRP, leading to the rollout of new commercial products.

Google's close collaboration with NASA and access to the agency's vast databases resulted in the release of Google Moon and Google Mars. These interactive products make exploration of the lunar and Martian surface easily accessible to all with a computer and offer a high-resolution, three-dimensional immersive experience. Users can "fly" across the surface of Mars, through canyons deeper than any on Earth, and around mountains many times taller than those on our planet. Moreover the Moon and Mars modes allow scientists to more readily engage in collaborative research by sharing data and findings.

The Global Connection Project is an example of how physical proximity offered by NRP facilitates collaboration, deep thinking, and innovation. The project — a collaboration among NASA, Google Inc., Carnegie Mellon University, and the National Geographic Society — has so far resulted in several products: disaster relief imaging; gigapixel resolution photographs; and the overlay of National Geographic images onto Google Earth. The origins of the Global Connection Project began with imaging technology developed for the Martian rovers. NASA Pancam technology, which creates a massive panorama by automatic stitching of dozens of photographs of the same scene, has been the basis for many spinoff Earth applications, including disaster relief. This project was honored in 2006 with the Accenture Economic Development Award by the San Jose Tech Museum.

Image NASA / USGS  
ESA / DLR / FU Berlin (GNeukum)

©2009 Google



## ***Space Portal Fosters Commercialization of Space and Entrepreneurship***

Since Congress amended the Space Act in 1985, NASA has sought to encourage “to the maximum extent possible, the fullest commercial use of space.” NASA Ames has been a leading Center for advocating and facilitating the commercialization of space and supporting space entrepreneurs.

### ***Space Portal: Providing Researchers with Space Access***

The Space Portal was established in 2005 to accelerate development of a new space economy by providing a “friendly front door” for organizations outside of NASA to work with the Agency and other entities on commercial space activities for public benefit.

This collaboratory of award-winning space entrepreneurs, scientists, engineers, technologists, and educators began as a volunteer brainstorming group that saw the potential for a new breed of commercial space developers to revolutionize the way the United States uses the remarkable, and largely still untapped, assets offered by the space frontier.

The Space Portal facilitates commercial access to government expertise and facilities; provides analyses of future trends and opportunities to senior decision-makers; builds alliances among suppliers of commercial space services, potential customers, and interested investors; and promotes space projects for humanitarian benefits, education, and commerce.

*The Space Portal at NASA Ames is laying the groundwork for the development of a robust space economy that will result in new companies and new jobs for America.*



Commercial Orbital Transportation Services Program (COTS)



Centennial Challenges Program



### Next Generation Inventors Win \$750,000 in Robotic Digging Competition

Twenty-three teams representing 12 states and Canada pushed their robotic digging machines to the limit to compete for \$750,000 in NASA prize money at this year's Regolith Excavation Challenge, held Oct 17-18 at NASA Research Park, Bldg. 503, Moffett Field, CA.

The event was co-hosted by the California Education & Workforce Institute and the California Space Authority(CSA) in collaboration with NASA, and held in a test area containing simulated lunar dirt, known as regolith. The two-day competition, open to industry, academia and individuals, required teams to design and build robotic machines that can navigate, excavate, and transfer a minimum of 330 pounds of regolith into a collector bin within 30 minutes.

Source: NRP Post, Winter 2009-2010, By Mark Newfield, Space Portal

Since its inception, Space Portal members have played key roles in developing several pioneering ventures to open the space frontier. These successes include NASA:

- ▶ Commercial Orbital Transportation Services Program (COTS) to stimulate efforts within the private sector to develop and demonstrate safe, reliable, and cost-effective space transportation capabilities;
- ▶ Centennial Challenges Program to encourage through competition and cooperation the participation of independent teams, individual inventors, student groups, and private companies in aerospace research and development;
- ▶ Commercial Re-usable Suborbital Research (CRuSR) Program that provides researchers access to the commercial suborbital spacecraft that are currently under development to conduct experiments, observations, and other investigations.

In addition, the Space Portal was instrumental in developing the first International Space Station National Laboratory Workshop chaired by Nobel Laureate Dr. Baruch Blumberg, inventor of the world's most widely used vaccine, and with a key-note speech by Dr. J. Craig Venter, renown as a key driver behind the revolutionary Human Genome Project. Other workshops led to the commercial development of a biotech startup business, a high fidelity educational game for Lunar exploration, and concepts for developing the workforce of the future through hands-on experiences in space.

Current projects in the Space Portal are focused on using space for science, technology, engineering and math education; demonstrating the value of in-space research and development for biotech and innovation; creating a roadmap for developing re-usable launch vehicles to reduce the cost of a payload to orbit by a factor of ten; bringing a broader commercial emphasis to sustained operations on the moon; and building an infrastructure for space development that becomes the backbone of this century's space-based innovation.



The Space Portal breaks down these barriers by providing entrepreneurs and non-contractor businesses access to NASA unique facilities and space itself. For example, the Space Portal recognized that space provides a useful and productive environment for biological and materials research. In a space environment not subject to gravity, atmospheric clouding, and other terrestrial forces, researchers can perform observations, and create new physical properties which are unachievable on Earth's surface. Biomedical device research, along with other industries, stand to benefit from this portal.

Importantly, the Space Portal also facilitates communication between launch and space flight service providers and space-users. Whereas one user may be unable to support a high-cost mission to space, the Space Portal promotes cost-sharing between users to lower the cost barrier. As a proponent of space-transportation, the Space Portal was instrumental in helping to develop NASA Commercial Crew and Cargo Program, which develops safe, reliable, and cost-effective space transportation.



International Space Station (ISS)



Green Aviation: Unmanned Aerial Vehicle (UAV)

## **Green Space Initiative Expands Green and Clean Technology**

According to the California Green Innovation Index and the Cleantech Group, California has emerged as the national leader in clean technology investment. Clean technology investment in California achieved an all-time high in 2008 of \$3.3 billion, nearly doubling 2007 investment levels. California attracts the largest share of cleantech venture capital investment in the U.S., accounting for 57 percent of total national cleantech venture capital investment in 2008. Attracting \$1.8 billion in 2008, Silicon Valley received more venture capital funding in cleantech than the rest of the state.<sup>2</sup>

NASA Ames is strongly committed to leading green/clean technology development in Silicon Valley. NASA Ames' Green Space Initiative aligns the Center's green activities with the NASA Missions and green activities of other NASA centers by providing strategy, integration, and implementation support for a diverse portfolio of alternative energy and environmental projects and initiatives. Table II-6 depicts the Green Space Initiative portfolio by application focus areas, current and targeted partnerships, and related programmatic and institutional projects.

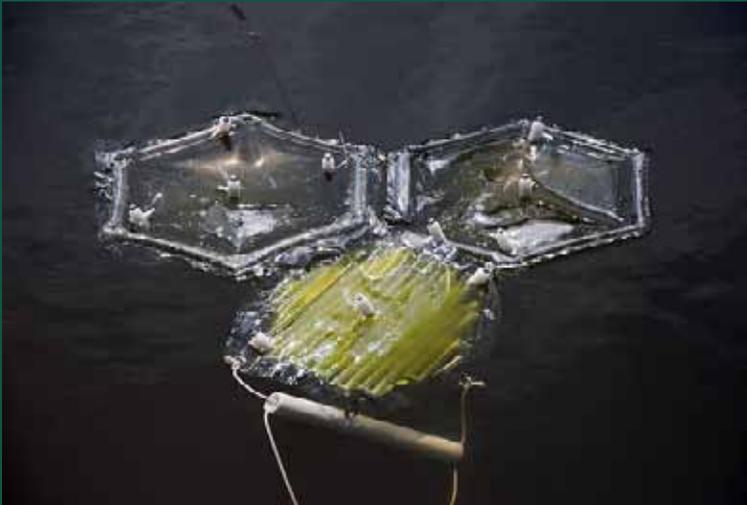
<sup>2</sup> Next 10. *California Green Innovation Index*, 2009.

### ***OMEGA: Algae Bioreactor as a Sustainable Energy Source***

Supported by NASA Aeronautics Research Mission Directorate and the California Energy Commission, the project's goal is to demonstrate the feasibility and scalability of OMEGA (Offshore Membrane Enclosure for Growing Algae) with respect to the biology, engineering, and economics, and to insure that its environmental impact remains beneficial at the large scale needed to replace our dependence on fossil fuels. The hope is that, based on this demonstration, people worldwide will realize the potential of OMEGA, and adapt and develop versions of OMEGA for the good of all.

OMEGA website: <http://www.nasa.gov/centers/ames/research/OMEGA/index.html>

The Green Space Initiative: <http://www.nasa.gov/centers/ames/Green Space/>



“The Algae OMEGA project is meant to provide significant quantities of sustainable, carbon-neutral biofuels, as well as food, fertilizer, and other useful products, while treating wastewater and sequestering carbon dioxide. It provides these products and services without competing with agriculture for land, fertilizer or freshwater.”

-- Jonathan Trent, Bioengineer researcher at NASA Ames Research Center and principal investigator and project scientist for the NASA OMEGA project

## *NASA Ames Wind Tunnel: Testing Truck Fuel Efficiency*



*Photo Credit: Daniel Terdiman/CNET*

Saving the nation \$10 billion annually in diesel fuel costs may be possible in a few years, thanks to new devices developed at Lawrence Livermore National Laboratory and now being tested at NASA Ames Research Center.

In support of the Department of Energy's mission to reduce the United States' dependency on fossil fuels, Lawrence Livermore National Laboratory (LLNL) has teamed with Navistar Inc. of Warrenville, Ill., NASA Ames Research Center, the U.S. Air Force and private industry, to develop and test devices for reducing the aerodynamic drag of tractor-trailers. The devices could increase the trucks' fuel efficiency by as much as 12 percent.

Tractor-trailers make up about 12 percent of the United States petroleum consumption or 21 million barrels per day. The average fuel mileage of a tractor-trailer is six miles per gallon. A two percent reduction in the aerodynamic drag of tractor-trailers translates into 285 million gallons of diesel fuel saved per year.

"We are delighted to host this important test that could help our nation save billions of dollars in fuel costs each year," said S. Pete Worden, director of NASA Ames. "This is an excellent example of what can be accomplished through our collaboration with other federal laboratories and industry."

Aerodynamic drag is caused from pressure differences around the vehicle. At highway speeds, a tractor-trailer uses more than 50 percent of the energy produced by the engine to overcome aerodynamic drag, while rolling resistance consumes roughly 30 percent of the usable energy.

LLNL is conducting a full-scale test in the world's largest wind tunnel, the National Full-Scale Aerodynamics Complex, also known as the NFAC, which operates under the direction of the Arnold Engineering Development Center at Ames. The goal is to identify drag reduction devices, both commercially available and under development, that show the potential for improving fuel efficiency. The wind tunnel test section's huge size, 80 feet by 120 feet, makes it ideal for testing a full-scale semi with a 53-foot trailer.

"This testing highlights a special opportunity for an Air Force-run facility to participate in research in areas beyond the Department of Defense and work to improve everyday issues such as fuel economy on national roadways," said Christopher Hartley, test engineer for Jacobs Engineering Group Inc., Pasadena, Calif., based at the NFAC.



**Table II-6.** Green Space Initiative Expands Green & Clean Technology

Green Space Portfolio	Global Monitoring And Prediction	CleanEnergy	Sustainable Systems
Applications	Climate Modeling Deforestation/Transport	Solar Material/Concern. Algae & Cellulose Thermal-electric conver. Fluid Dynamics	Env. Monitoring Air/Water/Waste Sys. Novel Transit Energy Efficiency Green Design/Products
Current Partnerships	CISCO Systems U.S. Department of Energy	Google Energy Algae Systems	MSGI Security Unimodal LLC NIOSH Redstone Arsenal
Value-Added FY2009	\$500K	\$330K	\$1,200K
Targeted Partnerships FY2010	Cisco (Urban) Cisco (Carbon) St. of California (CARB) DHS Trimble Navigation UC Davis	NREL/ Univ Wyoming DOE Biomass Live Fuels Hydromentia Bloalgene St. of Calif.(CEC) MSGI Security Planetary Society US Dept Ag. Google Inc. KOSHA Group	DHS IBS Inc. U.S. Department of Energy Paragon Space UC Davis
Related Programmatic & Institutional Projects	ARCTAS TC-4 Ecological Forecasting NASA-CASA Project NightSat	Exploration Life Support	Exploration Life Support

Source: NASA AMES Technology Partnerships Division





Thermal Paint Additive: Originally developed by NASA Ames scientists; now present in a number of commercially-available products

Green-related spinoffs developed from research and technologies at NASA Ames include a host of successfully commercialized NASA technologies that provide tremendous public and environmental benefits. NASA Ames' green-related technology commercialization program has contributed to the development of the following products since 2000:

- ▶ Computer Model Locates Environmental Hazards (2008);
- ▶ Sensor Network Provides Environmental Data (2007);
- ▶ Comprehensive Software Eases Aircraft Traffic Management (2007);
- ▶ From Planetary Imaging to Enzyme Screening (2006);
- ▶ Preventing Ice Before it Forms (2006);
- ▶ Water and Air Measures That Make "PureSense" (2005);
- ▶ A Coating That Cools and Cuts Costs (2004);
- ▶ Mapping a Better Vintage (2003);
- ▶ Building Safer Systems With SpecTRM (2003);
- ▶ Home Insulation With the Stroke of a Brush (2003);
- ▶ Cleaner Landfills (2000).

### Sustainability Base: The Nation's Most Green Federal Facility

In addition to research and development, NASA Ames is bringing its clean edge into practice by designing a revolutionary green building for development on-site. With a ground-breaking held in the summer of 2009, the \$20.6 million building will incorporate the latest green technologies and space technologies to create the first green demonstration and office building in a NASA Center.

Sustainability goals for the building include:

- ▶ Exceed LEED Silver with a plan for LEED Platinum;
- ▶ Create a highly flexible, collaborative and supportive work environment with community spaces, operational flexibility, daylight and views, operable windows, and healthy materials;
- ▶ Reduce energy demand through natural ventilation, daylighting, and intelligent control systems connected to the building monitoring system;
- ▶ Reduce, reclaim, and re-use water with high performance fixtures, gray water capture systems, rainwater bioswales, and connections to local non-potable sources;
- ▶ Provide a sustainable landscape with native and drought tolerant plant palette and drip irrigation tied to building gray water.



NASA Technology to Enhance 'Green' Building's Efficiency; NASA Ames Sustainability Base Building (N232)

*“The United States faces an enormous challenge because of the disparity it faces in labor costs. Science and technology provide the opportunity to overcome that disparity by creating scientists and engineers with the ability to create entire new industries— much as has been done in the past.”*

*Rising Above the Gathering Storm: Energizing and  
Employing America for a Brighter Economic Future  
National Research Council*

## ***STEM Education Develops a Workforce for the Innovation Economy***

It is widely acknowledged that America must educate the next generation with 21st century knowledge and skills to maintain our nation’s world-class workforce. To meet this challenge, NASA Ames runs a rich offering of educational programs in support of NASA goal to inspire the next generation of explorers. These programs address all levels of science, technology, engineering, and math education (STEM). A comprehensive approach to supporting and promoting STEM education is vital to maintaining the nation’s competitive edge in educational attainment, human capital, and labor productivity. These programs also contribute to the local, regional, state, and national economy by helping to establish and sustain a highly-trained, well educated workforce with skills needed to further research and technological advancements. NASA Ames actively supports federal, state, and local STEM education policy and program initiatives. The following section provides an overview of these programs at NASA Ames.



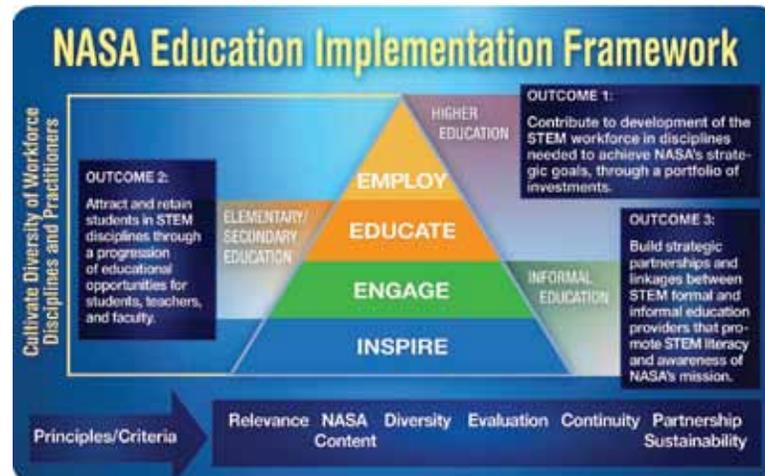


Figure II-4. NASA Education Strategic Framework

### NASA Education Strategy and Framework

STEM programs at NASA Ames follow and advance the overall strategic framework set by NASA (See Figure II-4). In 2006, NASA adopted the following major education goals:

- ▶ **Strengthen NASA and the Nation's future workforce –**  
NASA will identify and develop the critical skills and capabilities needed to ensure achievement of its exploration goals. To help meet this demand, NASA will continue contributing to the development of the nation's STEM workforce of the future through a diverse portfolio of education initiatives that target America's students at all levels, especially those in traditionally underserved and underrepresented minority communities;
- ▶ **Attract and retain students in STEM disciplines-**  
NASA will focus on engaging and retaining students in STEM education programs to encourage their pursuit of educational disciplines and careers critical to NASA future engineering, scientific, and technical missions;

- ▶ **Engage Americans in NASA mission—** NASA will build strategic partnerships and linkages between STEM formal and informal education providers. Through hands-on, interactive educational activities, NASA will engage students, educators, families, the general public, and all Agency stakeholders to increase Americans' science and technology literacy.

NASA Administrator Charles F. Bolden has determined that there is a national need to support improvements in STEM education. This determination was made in response to persistent concerns raised by President Obama, Congress, education experts, and numerous studies and reports documenting a crisis in the STEM education of our nation's students. This crisis in education, if not resolved, will contribute to future declines in employees to meet demand in critical career fields, U.S. global competitiveness, and the economy.

The support of the Obama Administration for STEM education improvement and inclusion of all populations in such activities is demonstrated through the announcements of several new initiatives and Federal commitments. "Educate to Innovate" and "Investing in Innovation", announced in the fall of 2009, call on industry, academia, schools, nonprofit organizations and other stakeholders in education, to work cooperatively to address STEM education needs. These initiatives are among the first national "calls to action" addressing the STEM education crisis as identified by experts and Congressional committees, including the *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future* report released in 2007. Having identified a national need to improve STEM teaching and learning, the NASA Administrator has decided to initiate a new STEM project, called the Summer of Innovation to be piloted in the summer of 2010.



**Table II-7.** Summary of STEM Education Programs at NASA Ames

<b>Primary and Secondary Education</b>
Educator Resource Center
Ames Exploration Encounter
NASA Digital Learning Network
NASA INSPIRE Program
Student Space and Biology Research Program
NASA Educator Resource Center Network
SOFIA's Education Program
Industry Initiatives for Science and Math Education
Exploration Center
Spaceward Bound
<b>Post-Secondary Education</b>
NASA Robotics Academy
NASA Cooperative Education Program
Education Associates Program
Pre-Service Teacher Institute
The Harriet G. Jenkins Pre-Doctoral Fellowship Program
NASA Academy at Ames for Space Exploration
Systems Teaching Institute
Tribal Colleges and University Project -- Native American Internships
University Research Centers
Graduate Student Researchers Program
United Negro College Fund Special Programs Corp.
National Administrator's Fellowship Program
NASA Postdoctoral Program
Undergraduate Student Research Program
Foothill-DeAnza Community College District Internship & Training Programs
Science Teacher and Researcher (STAR) Project
Student Career Experience/ Cooperative Education Program
Motivating Undergraduates in Science and Technology (MUST)

The new NASA initiatives encourage partnerships among government, primary and secondary educational institutions, post-secondary educational institutions, nonprofits and private industry to that will result in tangible benefits, including:

- ▶ Professional development and training opportunities for educators;
- ▶ An intensive and interactive middle school education experience;
- ▶ Strategic infusion of NASA content and educational resource materials;
- ▶ A community of STEM education stakeholders.

NASA Ames offers a comprehensive set of educational programs that focus both on teaching kids and training teachers in the areas of science, technology, engineering, and math. Table II-7 summarizes the array of programs; full descriptions of these programs are in Appendix B and can also be found at <http://www.nasa.gov/centers/ames/education/>.

### Ames Contribution to STEM Education

As a research center that specializes in research geared towards creating new knowledge and new technologies spanning the spectrum of NASA interest, NASA Ames' education program is focused on assuring that current and future generations of scientists and technologists will be available in the 21st century. STEM programs at NASA Ames follow and advance the overall strategic framework set by NASA.



## ***Specialized Research Facilities Create a Portfolio of National Assets***

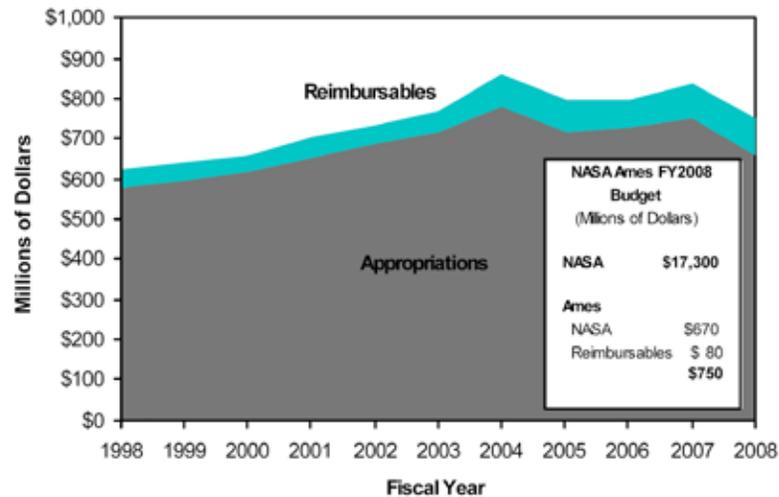
In addition to pursuing its leading-edge research programs, NASA Ames maintains specialized facilities that are recognized as national research assets, including:

- ▶ Actin Cytoskeleton Research Lab;
- ▶ Advanced Life Support Labs and Test Facilities;
- ▶ National Full-scale Aerodynamic Complex (NFAC);
- ▶ Ames Unitary Plan Wind Tunnel Complex (11-foot Transonic Wind Tunnel);
- ▶ Ames 9- by 7- foot Supersonic Wind Tunnel;
- ▶ Astrobionics Facilities: Sensor, Biotech, and Space Flight Hardware Integration Labs;
- ▶ Aviation Simulator Facilities;
- ▶ Human-Rated Centrifuges;
- ▶ Biosciences Laboratory;
- ▶ Crew Vehicle Systems Research Facility;
- ▶ Future Flight Central;
- ▶ Musculoskeletal Biomechanics Lab;
- ▶ NASA Advanced Supercomputing (NAS) Facility;
- ▶ Arc-Jet Complex;
- ▶ NASA BioVIS Technology Center;
- ▶ Vertical Motion Simulation Complex;
- ▶ Nanotechnology Materials Laboratory.



Hyperwall located in the NAS Facility

**Figure II-5.** NASA Ames Research Center Operating Budget, FY1998-FY2008



## Measuring the Economic Benefits of Ames

The NASA Ames campus generates significant economic stimulus to the local, regional, state and national economies. Employment and economic output, associated with employee spending patterns and productivity, are primary measures of this “benefit.”<sup>3</sup> The following analysis presents the quantitative employment and economic output associated with the traditional NASA Ames campus for the nine-county San Francisco Bay Area region, the State of California, and the United States.<sup>4</sup> Employment and economic factors measured include:

- ▶ NASA Ames Budget and Expenditures;
- ▶ Contracts Awarded (amount, recipients, and geography);
- ▶ Employment and Compensation;
- ▶ Direct, Indirect, and Induced Economic Benefits.

<sup>3</sup> Output is defined by the U.S. Bureau of Economic Analysis as sales or receipts and other operating income, commodity taxes, and inventory change

<sup>4</sup> The analysis excludes economic benefits generated by NASA Research Park; these additional benefits are presented in Part III of this report.



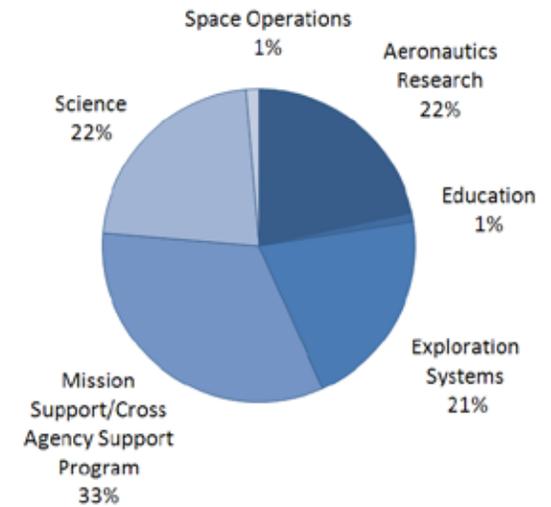
### ***Budget and Expenditures***

In Fiscal Year 2008, NASA Ames' operating budget totaled \$751 million. Of this total, NASA Ames received approximately \$670 million through NASA \$17.3 billion federal appropriation. In addition, NASA Ames obtained \$80 million of its FY 2008 operating budget through reimbursements from other government agencies and private entities (see Figure II-5).

NASA Ames' budget increased from 1998 to 2008, mirroring an increase in NASA overall budget and reflecting the nation's growing investment in space exploration. NASA Ames' revenue from reimbursable services also has increased in recent years, reflecting increased leasing and partnership activities.

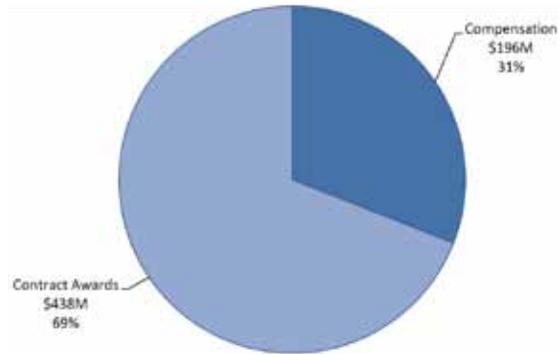
Funding for NASA Ames supports core enterprises such as Aeronautics Research, Education, Exploration Systems, Mission Support and Cross Agency Support programs, Earth Science, Space Science, and Space Operations. Figure II-6 provides a breakdown of the percent of appropriations budget allocated to each program in Fiscal Year 2008.

**Figure II-6.** NASA Ames Appropriations Budget by Mission, FY 2008



Sources: NASA Ames Research Center, 2009; BAE, 2009



**Figure II-7.** Budget Spending Breakdown, FY 2008

Sources: NASA Ames Research Center, 2009; BAE, 2009

### Compensation

Within NASA Ames' operating budget, two major categories of spending include performance awards to contractors and grantees, and compensation to NASA Ames' own civil servant employees. Figure II-6 presents the spending breakdown of NASA Ames' Fiscal Year 2008 budget for these two categories (a more detailed breakdown of spending by type of activity is presented in Tables II-7 and II-8). Approximately \$438 million, or 69 percent of NASA Ames' Fiscal Year 2008 budget, was spent through contracts and grants that were awarded to businesses, universities, non-profits and other government entities in the Bay Area, California, and throughout the United States. The remaining 31 percent, or \$195 million, provided compensation to NASA Ames' civil servant employees.

**Table II-7.** Contract Awards by State, Place of Performance, FY 2008 (\$ 000's)

Top 10 States	FY 2008	Percent
California	\$363,249,523	82.9%
Massachusetts	\$18,654,967	4.3%
Virginia	\$16,400,552	3.7%
Maryland	\$14,745,458	3.4%
Connecticut	\$3,248,025	0.7%
Florida	\$2,659,975	0.6%
Colorado	\$2,426,904	0.6%
Arizona	\$1,735,298	0.4%
Minnesota	\$1,622,700	0.4%
Texas	\$1,569,909	0.4%
Subtotal	\$426,313,311	97.3%
All Others	\$11,696,242	2.7%
<b>Grand Total</b>	<b>\$438,009,553</b>	<b>100.0%</b>

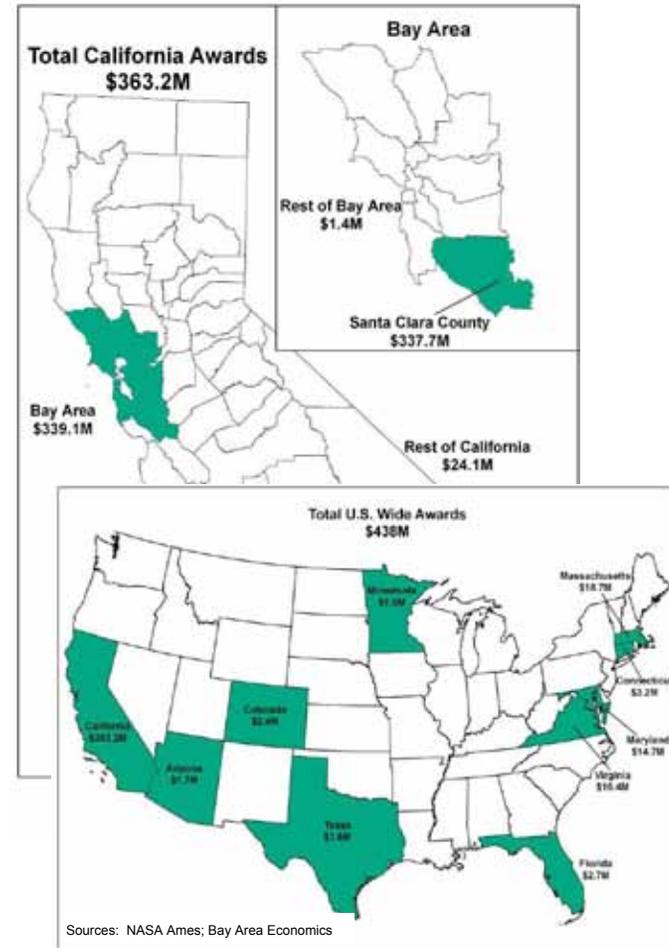
Sources: Federal Procurement Data System – Next Generation (FPDS – NG), 2009; BAE, 2009



### National Distribution of Contract Awards

Of the \$438 million in NASA Ames' contract awards in Fiscal Year 2008, Ames directed 83 percent, or approximately \$363 million, toward work that was performed within California. NASA Ames awarded the remaining \$74.8 million to private-sector companies and other entities in other states. Figure II-8 and Table II-7 on the previous page illustrates the Center's contract awards by state.

**Figure II-8.** Contract Awards to Contractors and Grantees, Place of Performance, FY 2008



**Table II-8.** California Contract Awards by County, Place of Performance, FY2008

Place of Performance	FY2008	Percent
Bay Area Counties		
Santa Clara	\$337,678,127	93.0%
San Mateo	\$658,789	0.2%
San Francisco	\$313,025	0.1%
Other Bay Area Counties	\$451,821	0.1%
Bay Area Subtotal	\$339,101,762	93.4%
Other California Counties		
Los Angeles	\$19,028,233	5.2%
Monterey	\$2,596,678	0.7%
Orange	\$1,366,906	0.4%
San Diego	\$429,451	0.1%
Santa Barbara	\$367,184	0.1%
Other California Counties	\$359,309	0.1%
Other Counties Subtotal	\$24,147,761	6.6%
California Total	\$363,249,523	100.0%

Sources: Federal Procurement Data System—Next Generation (FPDS-NG), 2009; BAE, 2009

### Geographic Distribution of Contract Awards in California

Table II-8 shows that of NASA Ames' \$438 million awarded in Fiscal Year 2008, contractors and grantees in California received approximately \$363 million. The San Francisco Bay Area received approximately \$339 million, representing 93.4 percent of NASA Ames' contract awards in California in Fiscal Year 2008.<sup>5</sup>

Contractors and grantees located in Santa Clara County (the location of NASA Ames) performed \$337.7 million in NASA Ames contracts. Contractors and grantees in other Bay Area counties performed approximately \$1.4 million worth of NASA Ames awards in Fiscal Year 2008. Because the majority of the work that is performed under these contracts and grants occurs at NASA Ames or within Santa Clara County, NASA Ames' contracting and grant-making activities function as a magnet, drawing a wide range of research and development activity into the Bay Area.

California counties outside the San Francisco Bay Area where NASA Ames' contract awards were performed in Fiscal Year 2008 included Los Angeles County (\$19 million), Monterey County (\$2.6 million), and Orange County (\$1.4 million). Maps in Figure II-7 illustrate the geographic distribution of NASA Ames' awards to contractors and grantees in Fiscal Year 2008.

<sup>5</sup> The San Francisco Bay Area includes nine counties: Alameda, Contra Costa, Marin, Napa, San Francisco, Santa Clara, San Mateo, Solano, and Sonoma.



### Distribution of Small Business Contract Awards

As previously discussed in this report, small businesses provide a significant economic engine and opportunity for advancement and technology. Of its \$438 million in contract awards, NASA Ames awarded over \$155 million to small businesses in Fiscal Year 2008. As shown in Figure II-9, the largest category of these contract awardees was classified as Minority Owned businesses, followed by Asian-Pacific American-Owned Businesses and Small Business Administration (SBA) Certified Small Disadvantaged Businesses.

**Figure II-9.** Categorization of Small Business Contract Awards by Socio-Economic Group FY 2008

Socio-Economic Group	Award Amount (millions)	Percentage of Total
Minority Owned Business	\$91.5	59%
Subcontinent Asian (Asian-Indian) American Owned	\$48.9	31%
SBA Certified Small Disadvantaged Business	\$43.1	28%
SBA Certified 8(a) Program Participant	\$25.5	16%
Black American Owned	\$20.0	13%
SBA Certified Hub Zone Firm	\$16.3	11%
Service Disabled Veteran Owned	\$15.4	10%
Emerging Small Business	\$14.5	9%
Woman Owned	\$12.2	8%
Native American Owned	\$9.4	6%
Asian-Pacific American Owned	\$6.5	4%
Hispanic American Owned	\$6.5	4%
Non Profit Organizations	\$1.7	0.01%
The AbilityOne Program	\$1.3	0.01%

**Note:** Contracts may be counted in more than one category.

**Source:** Federal Procurement Data System - Next Generation (FPDS-NG), BAE 2009



### Contracts and Awards Link NASA to California Private Industry

Awards to contractors and grantees link NASA Ames to a wide range of businesses, educational institutions, non-profit organizations, and governmental entities in California, the Bay Area and especially within Santa Clara County. Table II-9 shows that within the Bay Area, private-sector businesses performed 83.9 percent of all contract awards; educational institutions performed 5.1 percent; non-profits performed 6.0 percent; and other government 5.1 percent of contract awards in Fiscal Year 2008.

**Table II-9.** California Contract Awards by County, Place of Performance, FY2008

Bay Area Counties	Businesses	Education	Non-Profit	Other Gov't	Totals
Contra Costa	\$95,516	-	-	-	95,516
San Francisco	\$303,000	-	\$10,025	-	313,025
San Mateo	\$358,319	-	\$300,470	-	658,789
Santa Clara	\$283,292,770	\$17,252,397	\$19,957,901	\$17,175,059	337,678,127
Sonoma	\$71,188	-	-	-	71,188
<b>Bay Area Subtotals</b>	<b>\$284,120,793</b>	<b>\$17,252,397</b>	<b>\$20,268,396</b>	<b>\$17,175,059</b>	<b>\$338,816,644</b>
Percent	83.9%	5.1%	6.0%	5.1%	100.0%
<b>Other California Counties</b>					
Los Angeles	\$19,028,233	-	-	-	\$19,028,233
Monterey	\$2,596,678	-	-	-	2,596,678
Nevada County	\$5,725	-	-	-	5,725
Orange	1,366,906	-	-	-	1,366,906
Placer	8,993	-	-	-	8,993
Riverside	-	-	25,710	-	25,710
San Bernadino	7,500	-	-	-	7,500
San Diego	429,451	-	-	-	429,451
San Luis Obispo	-	-	180,000	-	180,000
Santa Barbara	367,184	-	-	-	367,184
Ventura	131,381	-	-	-	131,381
<b>Other California Subtotals</b>	<b>\$23,942,051</b>	<b>\$0</b>	<b>\$205,710</b>	<b>-</b>	<b>\$24,147,761</b>
Percent	99.1%	0.0%	0.9%	0.0%	100.0%
<b>Grand Totals</b>	<b>\$308,062,844</b>	<b>\$17,252,397</b>	<b>\$20,474,106</b>	<b>\$17,175,059</b>	<b>\$362,964,406</b>
Percent	84.9%	4.8%	5.6%	4.7%	100.0%

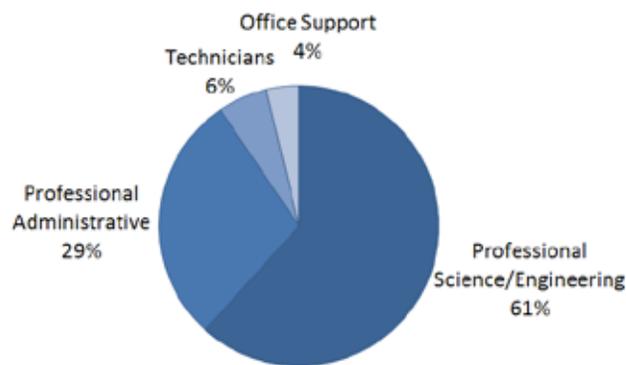
Sources: Federal Procurement Data System—Next Generation (FPDS-NG), 2009, BAE, 2009



*“As Ames explores space and our planet, it stimulates economic growth by employing scientists and engineering professionals, promoting technology innovation, and preparing the workforce of the future –all to enhance the health, growth, and long-term competitiveness of the Bay Area and the nation.”*

*Simon P. (Pete) Worden, Ph.D. Director, NASA Ames Research Center*

**Figure II-10.** NASA Ames Employees by Status, FY 2009

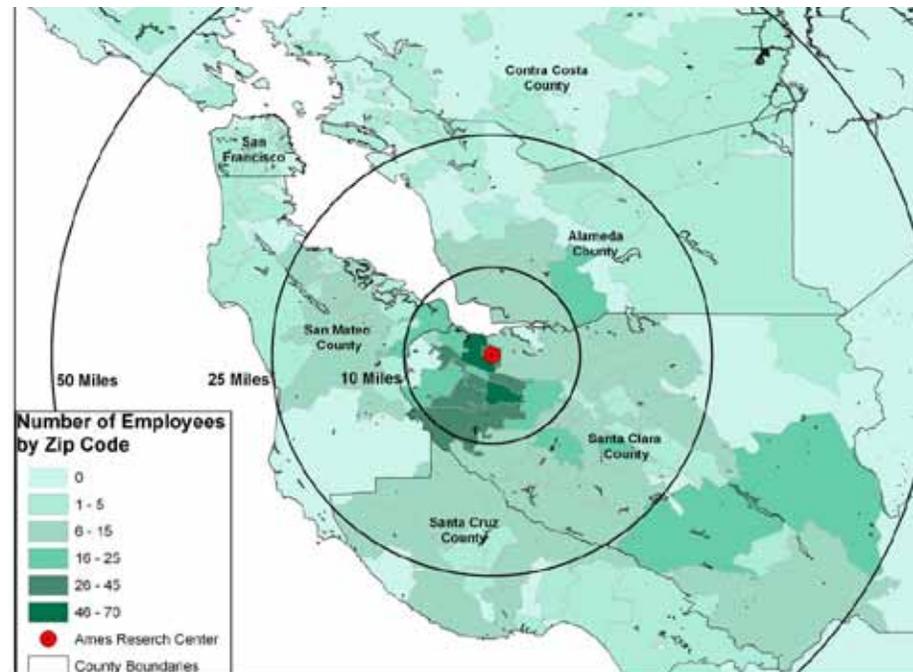


Sources: NASA Ames Research Center, 2009; BAE, 2009

**Employing a Highly Skilled and Highly Paid R&D Workforce**

An analysis of NASA Ames’ personnel database in March 2009 showed total staffing of approximately 1,300 civil servants. NASA Ames’ workforce consists principally of scientists, engineers and professional administrators, many of whom hold professional or advanced degrees (See Figure II-10). Data were not available for NASA Ames’ 1,200 full-time equivalent contractor employees.

**Figure II-11.** Civil Servant Employees by Zip Code (Bay Area Residents- FY 2008)



Compensation data for NASA Ames' approximately 1,300 civil servants show that in addition to being highly skilled, the NASA Ames workforce is highly paid. The average salary for a NASA Ames civil servant in Fiscal Year 2008 was over \$126,000. According to the NASA Ames personnel department, fringe benefits are estimated to make up an additional 21 percent of compensation. Table II-10 lists the total number of NASA Ames civil servant employees and compensation by home county in the Bay Area and California.

Employee data also indicate that 91 percent of NASA Ames' civil servants listed one of the San Francisco Bay Area's nine counties as their primary residence. NASA Ames' employees have commute patterns similar to other Silicon Valley workers, with most residing in northwestern Santa Clara County, southern San Mateo County, or southern Alameda County.

**Table II-10. Civil Servant Employees and Compensation by County, FY 2008**

Bay Area Counties	Employees	Total Salaries	Total Compensation
Alameda	108	\$12,998,519	\$15,786,701
Contra Costa	17	\$2,032,503	\$2,468,475
Marin	7	\$957,416	\$1,162,782
San Francisco	54	\$7,011,269	\$8,515,186
San Mateo	119	\$15,994,399	\$19,425,198
Santa Clara	853	\$107,353,350	\$130,380,644
Other Bay Area Counties	4	\$578,541	\$702,638
S.F. Bay Area Total	1,162	\$146,925,997	\$178,441,623
<b>Other California Counties</b>			
San Benito	9	\$1,198,161	\$1,455,167
Santa Cruz	31	\$4,310,149	\$5,234,676
San Joaquin	10	\$1,233,116	\$1,497,619
Stanislaus	5	\$528,756	\$642,174
Other California Counties	22	\$2,399,350	\$2,914,011
Other California Counties Total	77	\$9,669,532	\$11,743,647
Out of State	33	\$4,262,464	\$5,176,763
<b>TOTAL</b>	<b>1,272</b>	<b>\$160,857,993</b>	<b>\$195,362,032</b>

Sources: Federal Procurement Data System—Next Generation (FPDS-NG), 2009, BAE, 2009



## ***Employment and Economic Stimulus***

NASA Ames generates quantifiable financial benefits at the local, state, and national level as a result of its activities.

For the purposes of this economic benefits analysis, the San Francisco Bay Area region is defined as the nine counties of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma. A detailed explanation of the IMPLAN model and definition of key terms are presented in Appendix A.

Table II-11 shows the direct, indirect, and induced regional, statewide, and national impacts from NASA Ames' annual operations.<sup>6</sup> As shown, the operating activity provides the region with \$877 million in annual economic benefits and supports approximately 5,310 permanent jobs. Statewide, NASA Ames' operations generate approximately \$932 million in annual economic activity and 5,900 permanent jobs, while nationally, the Center generates \$1.3 billion annually and supports approximately 8,420 permanent jobs.

### ***Multiplier Effect***

Dividing each region's total output by its direct output indicates the economic multiplier that measures the economic activity of every dollar spent. Thus, every dollar of economic activity that occurs from NASA Ames' traditional operations generates approximately \$1.68 in local economic activity, \$1.76 within the State, and \$2.39 total within the nation. A detailed explanation of the multiplier effect is included in Appendix A, which outlines the IMPLAN model.

## **Tax Impacts**

In addition to estimating the direct, indirect, and induced impacts from operations, IMPLAN also provides estimates of local, state, and federal tax impacts. As the IMPLAN model does not provide a detailed breakdown of state and local taxes, this analysis uses Santa Clara County and State of California models to quantify tax impacts.

The county model shows state and local tax impacts from activity that occurs within the County, such as the direct impacts, both from local suppliers, and impacts from local workers. While the state model estimates the tax impacts from firms, suppliers, and workers located within California. According to IMPLAN, NASA Ames' economic activity within the County will result in total state and local taxes of approximately \$34.1 million per year, while economic activity within the State would result in total state and local taxes of approximately \$45.8 million annually. Table II-12 summarizes total tax impacts from the County and State models.

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<sup>6</sup> Direct benefits are NASA Ames' direct spending, net of tax payments; indirect benefits represent economic activity generated by business-to-business spending; induced benefits represent economic activity generated by employee household spending. A complete description of these concepts is presented in Appendix A.



**Table II-11. NASA Ames Research Center Economic Benefits, FY 2008**

Geography	Direct Benefits	Indirect Benefits	Induced Benefits	Total Benefits
Bay Area				
Output (a)	\$523,330,000	\$152,756,000	\$200,607,000	\$876,693,000
Employment	3,280	803	1,223	5,306
California				
Output (a)	\$530,684,000	\$165,215,000	\$235,785,000	\$931,684,000
Employment	3,377	963	1,564	5,904
United States				
Output (a)	\$551,503,000	\$294,832,000	\$472,417,000	\$1,318,752,000
Employment	3,578	1,689	3,156	8,423

Sources: IMPLAN; BAE, 2009

**Table II-12. NASA Ames Tax Impacts (2008 \$)**

Tax Recipient/Tax Category	Santa Clara County Model Total	State of California Model Total
State/Local Govt Non-Education		
Corporate Profits Tax	\$2,129,701	\$2,575,518
Dividends	\$3,384,508	\$4,092,999
Indirect Bus Tax: Motor Vehicle Lic	\$154,291	\$212,500
Indirect Bus Tax: Other Taxes	\$1,615,050	\$2,224,358
Indirect Bus Tax: Property Tax	\$6,134,642	\$8,449,050
Indirect Bus Tax: S/L NonTaxes	\$668,734	\$921,026
Indirect Bus Tax: Sales Tax	\$7,952,583	\$10,952,842
Indirect Bus Tax: Severance Tax	\$2,665	\$3,670
Personal Tax: Estate and Gift Tax	\$0	\$0
Personal Tax: Income Tax	\$9,049,657	\$11,594,316
Personal Tax: Motor Vehicle License	\$287,265	\$374,975
Personal Tax: NonTaxes (Fines- Fees)	\$1,757,572	\$2,336,271
Personal Tax: Other Tax (Fish/Hunt)	\$62,327	\$72,641
Personal Tax: Property Taxes	\$99,148	\$144,242
Social Ins Tax- Employee Contribution	\$145,273	\$348,766
Social Ins Tax- Employer Contribution	\$625,012	\$1,500,505
<b>Total: State/Local Government</b>	<b>\$34,068,428</b>	<b>\$45,803,680</b>

Sources: IMPLAN; BAE, 2009



***PART III:***  
NASA RESEARCH PARK DELIVERS RESULTS





## Part III: NASA Research Park Delivers Results

In its seventh year, NASA Research Park (NRP) – a collaborative community sponsored by NASA Ames – continues to broaden its impact on the local, regional, and national economy. Part III presents an overview of NRP, its current industry, academic, non-profit and government partners, and estimates the economic benefits of NRP related to both planned construction and future full occupancy. These benefits are in addition to those generated by the NASA Ames campus (discussed in the Part II of this report).

The following elements work together to illustrate NRP's role in fostering collaboration and providing economic benefits:

- ▶ Key partnerships that have been fostered and continue to develop through NRP (including Spotlights illustrating technological advancements, and an overview of educational partners);
- ▶ Tangible programmatic and financial benefits;
- ▶ World-class STEM programming;
- ▶ Environmental sustainability;
- ▶ Awards and honors that recognize NRP contributors;
- ▶ Community outreach programs that promote sustainability and space exploration;
- ▶ The measurable economic benefits generated by the NRP.

*“Innovation is collaborative and networked... to stay abreast of change and speed up the commercialization process, the walls that once separated public and private institutions, education and business, large and small firms, are coming down.”*

*Bay Area Council Economic Institute, The Innovation Driven Economics Development Model, 2008*

### **NRP Accomplishments at a Glance:**

- ▶ *Environmentally entitled for up to 5.7 million square feet of new construction;*
- ▶ *70 on-site partners at present;*
- ▶ *675,000 square feet leased and occupied;*
- ▶ *42 acres leased to Planetary Ventures LLC; 1.2 million square feet office/R&D Google, Inc. campus;*
- ▶ *77 acres leased to University Associates, LLC. to develop 2.9 million square feet of office, educational, R&D, and housing;*
- ▶ *More than \$14 million in lease revenue and cost reimbursement in Fiscal Year 09.*





NASA Research Park: 2020 Campus Plan. Image Courtesy of AECOM

### ***NRP Collaboration Strengthens Key Partnerships***

NASA Research Park is uniquely positioned as a nourishing and dynamic environment for cutting-edge research and education. Through this NRP initiative, NASA Ames is creating:

- ▶ A world-class shared-use R&D and education campus for industry, academia, non-profits, and government;
- ▶ A center for innovation and entrepreneurship;
- ▶ A unique community of scientists, engineers, students and educators with a shared mission.

As a physical place, NRP fosters both informal and formal interactions through careful master planning and site planning of streets, sidewalks and public spaces as well as careful selection of tenants. It is widely acknowledged that innovation depends on bringing multiple disciplines together to engage in collaborative projects that often yield unpredictable, but highly productive results.

Located in the heart of Silicon Valley, NRP draws upon a deep pool of well-respected researchers both at NASA Ames and in the regional community of colleges and universities, technology-oriented nonprofits and high-tech R&D companies.

## ***NRP Partnerships***

Vital and robust partnerships are the key to NRP success. NASA Ames selects partners based on their ability and potential to develop advanced technologies relevant to meeting NASA mission requirements. NASA Ames applies partner selection criteria formulated to support this tenant attraction strategy. Once a tenant at NRP, NASA partners also pay their share of costs, reducing NASA Ames' shared fixed operating costs and backlog of capital improvement projects.

Since commencing its leasing activities in 2003, NRP has exceeded all expectations. At present, over 675,000 square feet has been leased and 70 agreements with a wide range of industry, academic, and government entities have been signed to date. NRP partners are making tangible contributions to NASA while pursuing their own business plans. A complete list of current partners is shown in Table III-1 and several spotlights of these partnerships are presented throughout this report. These spotlights represent a range of industry partners, each focusing on a different aspect of technological advancement.

*“NASA Research Park serves as a magnet for talent, companies, and investment, accelerating the natural progression of innovation in Silicon Valley. The NRP gives the region an extra edge in a highly competitive global marketplace.”*

*Lewis S.G. Braxton III, Deputy Director, NASA Ames*



**Table III-1.** Partners at NASA Research Park (October 2009)

	<b>Industry Partners</b>	<b>Area of Research</b>
1	Airship Ventures Inc.	"Lighter than air" technologies for atmospheric research and tourism transportation
2	Aris Helicopter Ltd.	Aerial construction & heavy lift operations
3	Bloom Energy Corporation	Developer of clean, high-efficiency and reliable solid oxide fuel cell systems
4	Changene Inc.	Bone density growth
5	Digiproofs Inc.	Digital imaging
6	E4xchange Corporation	Application of nano particles to inkjet print technology
7	Ecliptic Enterprises Corp.	Specializes in providing ruggedized imaging systems, data-handling units, and payload-controlling avionics optimized for the extreme environment of space launches and travel
8	Geo-G2 Solutions Inc.	Provides aerial imagery data and analysis solutions for managing agricultural and forestry markets in the United States
9	H211, LLC	Atmospheric research
10	Intelligent Inference Systems Corp.	Develops intelligent fault diagnosis/prognosis software
11	Informart/ Gary Air	Information technology solutions for the general aviation industry
12	Intelligentek Corporation	Security software
13	International Network Solutions Inc.	Wireless solutions for R&D and metro scale networks
14	Intrinsyx Technologies Corp.	Provides information technology solutions to federal, state, and commercial entities
15	Kleenspeed Technologies Inc.	Scalable electric propulsion systems
16	LB&B	Airfield services
17	Lifesource Biomedical LLC	Provider of drug discovery and pre-clinical research services
18	Lockheed Martin	Defense contractor
19	M2MI Corporation	Automated operations of global networks of computers and networked equipment
20	Millenium Engineering	Mission assurance and safety, system engineering and analysis, hardware design and rapid prototyping, sensor technologies & power systems
21	NXAR LLC.	Software development for knowledge network systems
22	Photozig	Integrated digital photo technology
23	Planetary Ventures LLC	New R&D campus for Google in NRP's Bay View district
24	Planners Collaborative Inc.	Provides integrated technical information, education, and communication support
25	Pragati Synergetic Research, Inc.	Knowledge engineering software
26	Qtch Inc.	Voice-operated "virtual assistant"
27	Rapiscan Systems	A leading provider of security screening solutions
28	RMV Technology Group LLC	Electrostatic discharge materials testing
29	SAIC	Provide atmospheric science research, technology, and services



	<b>Industry Partners</b>	<b>Area of Research</b>
30	SGT Inc.	Aerospace services company
31	Space Systems Loral	Designer, manufacturer, and integrator of geostationary satellites
32	Tesla Motors, Inc.	Testing of an advanced Li-ion battery pack
33	Tibion Corporation	Muscle augmentation technology (e.g., "Power Knee")
34	Topquadrant Inc.	Web solutions to help integrate data, applications, and processes
35	Unimodal Systems LLC	Working to develop personal rapid transit system
36	Zenpire Corporation	Tests open source software for information access and storage
37	Zero-Gravity Corporation	Airfield use for zero-gravity experience
	<b>Academic Partners</b>	<b>Area of Research</b>
38	Carnegie Mellon University	Information technology, software engineering, and robotics R&D academic programs
39	University Corporation at Monterey Bay	Development of environmental monitoring networks
40	Santa Clara University	CREST program; study of astrobiology, biotechnology, and nanotechnology
41	Singularity University	Interdisciplinary leadership program focused on how to use technology to solve problems
42	University of California Santa Cruz	Silicon Valley Center- academic programs include engineering, technology and information management, knowledge services and enterprise management
	<b>Non-Profit Partners</b>	<b>Area of Research</b>
43	Airship Earth	Natural disaster response, global climate change research, STEM education
44	Collings Foundation	Vintage military aircraft preservation
45	Kentucky Science & Technology Corp.	STEM education, information technology R&D, space research projects; biotech on International Space Station
46	Mars Institute	Mars analog field site, exploration technologies
47	Moffett Field Historical Society	Interpretation of Moffett Field history and NASA public outreach
48	Space Grant Education & Enterprise Inst.	STEM education, commercialization of space/space entrepreneurship
49	SRI International	Nonprofit institute
50	UAV Collaborative	R&D of unmanned aerial vehicles (UAVs) for scientific and commercial use
51	UNCF Special Programs Corp.	Provides research experiences for undergraduates in STEM disciplines
52	Western Disaster Center Inc.	Natural disaster loss-prevention technology



	<b>Government Partners</b>	<b>Area of Research</b>
53	California Air National Guard, 129th Rescue Wing	Airborne search and rescue for combat and peacetime missions, natural disaster assistance
54	BRAC Program Management Office, West	Department of Defense base closure and realignment regional office
55	Bureau of ATF	Storage
56	City of San Jose	Airfield utilization
57	City of Sunnyvale	Municipal golf course
58	Defense Commissary Agency	Commissary for military personnel
59	Defense Energy Support Center	Fueling service for Moffett Federal Airfield
60	Domestic Nuclear Detection Office (DNDO- Homeland)	Detection and reporting unauthorized attempts to import, possess, store, develop, or transport nuclear or radiological material
61	Federal Emergency Management Agency	Western Region Logistical Operations Center
62	National Nuclear Security ADM	Part of the United States Department of Energy
63	Naval Facilities Engineering Command	Manages the planning, design and construction of shore facilities for U.S. Navy activities around the world
64	Santa Clara County Sheriff	Training
65	U.S. Air Force (AEDC)—NFAC Facility	Aeronautics and rotorcraft research
66	U.S. Army 63rd Regional Readiness Command	Base and administrative support to over 40,000 Army Reserve soldiers in the southwest United States
67	U.S. Army Aeroflightdynamics Directorate	Aviation research and technology development programs
68	U.S. Army 7th PSYOP Group	Psychological operations unit of the United States Army Reserve
69	U.S. Army Garrison	Military housing
70	U.S. Army Combat Support Training Ctr.	Military housing, military intake processing station

Notes: List as of October, 2009; does not include NASA contractors utilizing NASA-provided facilities.

Sources: NASA Ames, NASA Research Park Office, 2009; BAE, 2009



## ***NRP Delivers Tangible Programmatic and Financial Benefits***

NASA Ames has realized tangible benefits from its NRP initiative. Through enabling on-site long-term partnerships, NRP brings the best new ideas and technologies to NASA. Universities such as Carnegie Mellon undertake basic research as well as applied technologies for dependable software, robotics and high-performance computing. UC Santa Cruz pursues space science and bio-info-nano convergence technologies. Santa Clara University's Center for Robotics Exploration Space Technology (CREST) program sponsors six university participants that are developing small satellites in support of NASA programs. NRP tenants in the life sciences, such as Changene and Tibion Corporation, focus on product development that benefits NASA Human Factors Research. As other examples in this section show, the NRP environment supports and celebrates innovation and breakthrough discoveries.

Financially, NRP is providing strong returns to the Agency. Total lease revenue from NRP leasing activity has grown from approximately \$350,000 in Fiscal Year 2005 to over \$14 million in Fiscal Year 2009. Revenue from NRP benefits NASA Ames in several important ways, including:

- ▶ Leases generate net rent revenue to fund critical capital improvements at NASA Ames, allowing NASA Ames to monetize its real property assets while retaining control for programmatic purposes;
- ▶ Institutional Share Pool (ISP) charges generate cost reimbursement revenue that significantly lowers NASA Ames' fixed costs of Center operations; and
- ▶ The rehabilitation of existing buildings with private capital secured by NRP tenants permits NASA Ames to reduce its deferred maintenance backlog.

The following case studies illustrate programmatic benefits realized by organizations at NRP.

### ***Ecliptic Enterprises***

*“We love being at NRP because of its proximity to our customers and opportunities to interact with others at Ames events.”*

*Rex Ridenoure  
CEO, Ecliptic Enterprises Corporation*

*“The most important work occurs primarily in face-to-face exchange within teams where people work in close proximity to each other. The most rapid advances in a trial-and-error, iterative learning process take place through in-person information exchanges. Face-to-face interaction remains important in the Internet age.”*

*The Innovation Driven Economic Development Model,  
Bay Area Council Economic Institute, 2008*



# Intrinsyx

## *Intrinsyx Technologies: Award Winning Support to Constellation*



NRP tenant and subcontractor, Intrinsyx Technologies support all data systems aspects of the Agency's Constellation project at NASA Ames, including: systems engineering, requirements management, enterprise architecture, IT security, semantic modeling, and software development for a large number of enterprise applications.

Intrinsyx is also solely responsible for developing the Security Operations Center Incident Management System implementation. In September 2008, two Intrinsyx personnel received an Ames Honor Award for their work on behalf of the Security Operations Center.





### ***CREST: Launching GeneSat-1 to Explore How Space Affects Life***

Center for Robotic Exploration and Space Technologies (CREST) teamed with the NASA Ames' Small Spacecraft Office to develop a fully automated, miniature spaceflight system that provides life support for small living things. GeneSat-1, the first such system, was successfully launched in December 2006. Its mission was to use genetic technologies to study metabolic changes of bacteria during spaceflight.

University students were essential members of the GeneSat-1 mission team. Students at Stanford University prototyped early designs for satellite components. Students at Cal Poly, San Luis Obispo developed a launch 'pod' that protected and ejected the satellite once it reached space. Once GeneSat-1 was in orbit, Santa Clara University students controlled the spacecraft from a mission operations center at NASA Ames as well as developed software that sent commands to the satellite, calibrated biological data, and analyzed spacecraft health.

As a follow-on project, NASA and CREST launched PharmaSat in May 2009. PharmaSat was designed to measure the influence of microgravity upon yeast resistance to an antifungal agent. This satellite implemented principal investigator-guided science focused on questions key to countermeasure development for long-term space travel and habitation. CREST will provide mission operations for two additional NASA satellite spacecraft to be launched in early 2010.

Flying multiple missions using low cost secondary payload technology will help scientists better understand how the space environment—which includes radiation and reduced gravity—affects living things. This new knowledge will enable scientists to develop new defenses against the space environment's hazards. These countermeasures are critically needed for safe, long-duration human space missions.

## UNIMODAL SYSTEMS

### *Unimodal: Personal Rapid Transit*

Unimodal Systems LLC, located at NRP, is developing a next generation high-speed transportation system that will revolutionize how transportation planners deploy public transit. The system, SkyTran, uses small vehicles running on elevated, magnetically levitated guideways, which distinguishes it from other rail systems. The vehicles are lightweight, personal compartments that can transport up to three passengers. Travelers board the pod-like vehicles and select their destination on a touch screen. Using intelligent control system software, SkyTran will run nonstop



point-to-point service without interrupting the flow of traffic. These vehicles will eventually travel up to 150 mph and move 14,000 people per hour, both locally and regionally. SkyTran can serve as a feeder system to other transit systems, such as BART and high-speed rail. Unimodal and NASA have entered into an agreement to collaborate on the use of NASA control software, prognostic tools and human factors techniques to develop autonomous vehicle control that provides safe and reliable operation of the SkyTran system.



### ***Green Trails & INET: “Civilization in a Box”***

NRP-based Green Trail Energy Inc., in collaboration with International Network Solutions, Global Wireless Communications (I-Net) and North Star Fabrication, has manufactured the first clean energy based mobile telecommunications system that can be deployed for disaster response in developing countries or domestically.



A wind turbine, sun tracking solar system and heavy-duty telescoping tower fold into a package the size of a standard sea container for economic shipping worldwide. It can be deployed by one person, producing power and transmitting in less than 30 minutes. The patent pending 106 ft. tower system and folding communications array can support most wireless equipment including for WiMAX, UMTS, LTE, CDMA, GSM and/or Wi-Fi. Extra onboard power can easily be utilized to provide other basic necessities, i.e. light, water purification, and irrigation. It is truly “civilization in a box.”

### *KleenSpeed Technologies Inc.: Scalable Electric Propulsion Systems*



KleenSpeed Technologies, Inc. was founded in November 2007 to develop technology, products and systems for the rapidly emerging electric vehicle industry. A partner at NRP since September 2008, KleenSpeed uses racing cars, which have been converted to total electric power utilizing KleenSpeed systems, as a laboratory and test bench to develop and test products. KleenSpeed brings state-of-the-art technologies to a range of other consumer and industrial vehicles.



## *Bloom Energy Corporation: Breakthrough Fuel Cell Technology*

K.R. Sridhar used to spend his time as a researcher at NASA Ames Research Center looking at the sky and dreaming of ways to sustain life on Mars. Now, CEO of Bloom Energy, Sridhar heads a company that just unveiled new technology that could make energy cleaner, cheaper, more reliable and accessible to everyone in the world.

The journey from NASA to Bloom Energy started with Sridhar and a small team of university researchers working to build a fuel cell powered module to go to Mars. When their NASA project ended, the team left academic life, opened a research and development office in NASA Research Park, and began working to commercialize the fuel cell technology with a new company, ION America, which became Bloom Energy.

Invented over a century ago, fuel cells have been used in practically every NASA mission since the 1960s. However, they have not gained widespread acceptance because of their inherently high cost. Traditional fuel cell technology used precious metals but this technology uses sand. Sand is inexpensive, which Sridhar asserts makes the Bloom Energy technology affordable and easy to mass produce.

Bloom Energy has experienced success solving numerous technical challenges in fuel cell science and engineering, producing the most efficient and “greenest” stationary fuel cell technology in the world, developing cost-effective manufacturing, and proving the reliability and performance of its commercial products through countless hours of testing at the NRP. This work has led to multiple patents.

Bloom Energy reports that its NRP location has provided many benefits including:

- ▶ Ability to maintain and build close relationships with senior NASA staff, opening the door for continued collaborative partnerships;
- ▶ Proximity to the scientific, engineering, and business talent;
- ▶ A strategic physical location in the center of Silicon Valley;
- ▶ Access to networks of entrepreneurial companies and venture capitalists;
- ▶ Enhanced security through staffed gates at NASA Parkway and Ellis Street.

In 2005, Bloom Energy expanded to a new corporate headquarters and manufacturing facility in Sunnyvale, a short five-minute drive from NRP. The NRP facility is still fully operational and used by Bloom Energy; it is now devoted primarily to testing and research and development. Since its founding in 2002 with a small technical team, Bloom Energy has grown to a workforce of over 300 people both locally and at its facility in India, employing a diverse and talented team of researchers, engineers, and business people.





### ***The Collaborative for Higher Education: Addressing STEM Education***

The Collaborative for Higher Education (the Collaborative) was formed in 2000 as a way to address California's technology, education challenges in a coordinated and comprehensive way. The Collaborative's primary objective is to create a statewide model of higher education institutions working together with a seamless delivery of teaching and training in STEM fields.

Formed by the President and Chancellors of the University of California Santa Cruz, San Jose State University, and Foothill-De Anza Community Colleges, the Collaborative leverages its collective talent, resources and intellectual leadership to address California's changing demands for education, workforce development, real-world training opportunities and lifelong learning.

Specific areas of focus for the Collaborative include:

- Provide professional development training in STEM for teachers
- Create a pipeline of STEM coursework that facilitates a smooth transition from high schools, to community colleges, and to the UC and CSU campuses
- Motivate and engage Silicon Valley students, focusing on historically underrepresented populations in STEM field
- Motive adults disenfranchised or disconnected from the new economy to pursue science and technology careers
- Help working professionals to upgrade their STEM skills and maintain their competitive edge

## ***NRP Attracts World Class Universities***

NASA Ames has entered into several highly productive partnerships with educational organizations and institutions of higher learning that have or will have on-site facilities and operations at NASA Research Park. These programs are unique to NASA Ames and supplement the agency's educational programming by offering new approaches and new learning environments to support STEM education.

### **Carnegie Mellon University – Silicon Valley Campus**

In 2002, Carnegie Mellon University (CMU) established a west coast campus for science and engineering research and education at NRP. CMU rehabilitated several historic structures in the Shenandoah Plaza Historic District to house classrooms and research facilities. CMU's "Carnegie Mellon Silicon Valley" has granted over 400 degrees since its opening, offering part-time, full-time, and bicoastal masters' degree programs in information technology, technology innovation management, software engineering, and software management. Recently, CMU has initiated a new bicoastal Ph.D. program in electrical and computer engineering mobility.

CMU's research programs are focused on topics of interest to NASA: software engineering, software management, and robotics. Their current projects and areas of research include: autonomous trustworthy computing platforms and devices, certification of adaptive control for manned and unmanned aircraft, cyber-physical systems foundations, intelligent monitoring and control of building integrated photovoltaics, intelligent systems lab, reliable, robust and secure networking, SensorFly, SmartSpaces, stochastic methods for neural network robot control, and visualization of analytical processes. CMU was a partner of Google Inc. and NASA Ames in the award-winning Global Connection Project.



August 2008 graduation ceremony at Building 23, NASA Research Park  
*Photo Courtesy of Carnegie Mellon University*

*“CREST supports collaboration between students at different schools in support of NASA Ames and major aerospace companies. Cross university collaboration is critical to the success of space exploration”*

*Dr. Eugene Tu, Ames Director for Exploration Technology*

### **Santa Clara University and Center for Robotic Exploration and Space Technologies (CREST)**

CREST is a local and national academic consortium operated by Santa Clara University and is designed to foster and promote strategic partnerships among private industry, government agencies and education and research institutions. The mission of CREST is to support hands-on engineering education, advanced technology demonstrations, and scientific discovery.

CREST evolved in 2006 from the Space Technology Center, formerly comprised of San Jose State University, Santa Clara University, Stanford University and California Polytechnic State University. CREST reorganized to signify an expansion in scope and membership, which now includes more than a dozen universities and organizations from Silicon Valley and throughout the United States. A formal Memorandum of Understanding was developed with Santa Clara, Stanford, and San Jose State Universities, Ohlone College, Cal Poly San Luis Obispo, and discussions are being held with UCSC, Mills College and the National Hispanic University. Nationally CREST has partnerships in development with Northeastern, Washington, Montana and Iowa state universities, the University of Kentucky and the Mid-Atlantic Institute for Space and Technology.

CREST's new scope includes a range of robotic missions and technologies: marine robotics, land rover clusters, unmanned aerial vehicle platforms and instruments. In addition, the program is focused on small satellite development and operations utilizing innovative, low-cost design strategies and streamlined development processes. Research specialties include autonomous reasoning for tele-robotic systems, multi-robot systems, composable design (“plug and play” missions) and Earth sciences applications. CREST will continue to provide student education and workforce training via educational programs in robotics, aerospace and spacecraft for K-12 through graduate research.



## University of California—Silicon Valley Center

The University of California system, led by its Santa Cruz campus (UCSC), has established NRP as the location for its “Silicon Valley Center” that houses a set of educational and research activities that increase the presence of the University of California in Silicon Valley.

Currently UCSC occupies a significant portion of historic Building 19 at NRP, offering courses in computer engineering, network engineering, technology and information management, and knowledge services and enterprise management. UCSC’s Bio | Info | Nano R&D Institute (BINRDI) is also based at NRP. BINRDI assembles the extensive research talents of UCSC, NASA Ames, and industrial affiliates like Hewlett-Packard, to engage in research at the cutting edge of “convergence science,” representing the nexus of multiple disciplines, where biologists, chemists, physicists, engineers, and others work together to develop next generation technologies.

## United Negro College Fund Special Programs Corps

The UNCF Special Programs Corporation established the Summer Scholars Program and the Summer Faculty Fellowship Program at NASA Ames. In their fourth year of operation, these two programs bring together students and faculty from historically black colleges and universities, Hispanic-serving Institutions, tribal colleges and universities, and other minority institutions to get hands-on research experiences at NASA centers, as well as experience in research proposals, managing technical projects and for career advancement opportunities. These programs are successfully engaging the minority higher education community in government and industry research and contributing to STEM education in populations that are underrepresented in America’s scientific and research community.

After starting at NASA Ames, the Summer Scholars Program has been expanded to include scholar placements at Johnson Space Center in Texas and Glenn Research Center in Ohio.





**Foothill College**  
Upgrade. Advance.



Unmanned Aerial Vehicle (UAV)



### Foothill-De Anza Community College District

The Foothill-DeAnza Community College District (FHDA) has joined NASA Ames as a partner in developing an academic center at NRP. The mission of Foothill-De Anza Community College District is to provide undergraduate preparation for university transfer and workforce development. Since 1970, FDHA has conducted a highly successful grant-funded internship program at NASA Ames. As an NRP partner, FHDA will offer programs to college students interested in pursuing careers or transitioning careers to information technology, astrobiology and the life sciences, engineering, mathematics, and physical sciences. As part of its participation in the University Associates-Silicon Valley LLC, FHDA is planning a facility with approximately 100,000 square feet of classroom, laboratory, and office space at NRP.

### The UAV Collaborative

The UAV Collaborative is a partnership of 30 entities, including NASA, Lockheed Martin, San Jose State, California State University at Monterey Bay, and New Mexico State University, that promotes the research and development of unmanned aerial vehicles (UAV) for scientific and commercial use. The UAV Collaborative has a four-year cooperative agreement with NASA. The joint goal is to conduct collaborative research, development, and demonstration, leading to enhanced scientific and commercial use of UAVs for high resolution imaging in the National Airspace System.

### Singularity University

Singularity University (SU) was founded in 2008. With the support of NASA, Google Inc., and a broad range of technology thought leaders and entrepreneurs, the new university established a location at the NRP in the summer of 2009. Its goal is to prepare the next generation of leaders to address “humanity’s grand challenges.” SU provides a nine-week graduate-level interdisciplinary curriculum and a three- or ten-day executive program designed to facilitate understanding, collaboration, and innovation across a broad range of carefully chosen scientific and technological disciplines whose developments are exponentially accelerating.



## International Space University

International Space University (ISU) was established in 1987 as an institution founded on the vision of a peaceful, prosperous and boundless future through the study, exploration and development of space for the benefit of all humanity. ISU's permanent campus is located in Illkirch-Graffenstaden near Strasbourg, France. The Strasbourg campus offers two masters' programs in space studies and space management. A two-month long space studies program is held in a different city each year. The ISU was founded on the "3-I" philosophy to create an Interdisciplinary, Intercultural and International environment for study and training as a space professional.

NASA Ames hosted the 2009 ISU Summer Session Program, attended by approximately 120 students from all over the world and an international cadre of distinguished professors. The curriculum covered the major space-related fields, both technical and non-technical, and ranged from engineering, physical sciences and satellite applications to life sciences, policy, management and humanities. Key factors in NASA Ames' selection were its location in Silicon Valley, its world-class scientists and its ongoing collaborations with academia and the entrepreneurial space community.

*“Singularity University is a profoundly and uniquely futures-oriented institution. It's very purpose is to identify and use exponentially-accelerating technologies to create better conditions for everyone on Earth; to heal and nurture the planet itself; and to guide humanity as it reaches beyond the limits of Earth.”*

*Dr. Peter H. Diamandis  
Co-Founder & Chairman, Singularity University  
Co-Founder International Space University*



International Space University Poster Program Announcement



International Space University Summer Session





### ***United Negro College Fund Special Programs Corporation: Summer Scholars and Faculty Fellows***

The United Negro College Fund Special Programs Corporation established a Summer Scholars and Faculty Fellows program at NASA Ames. In their fifth year of operation, these two programs bring together students and faculty from historically Black Colleges and Universities, Hispanic-serving Institutions, Tribal Colleges and Universities, and other minority institutions to get hands-on research experiences at NASA centers, as well as experience in grant writing and for career advancement. These programs are successfully engaging the minority higher education community in government and industry research and contributing to STEM education in populations that are underrepresented in America's scientific and research community.

After starting at NASA Ames, the program has been expanded to include scholar placements at Johnson Space Center in Texas and Glenn Research Center in Ohio.





### ***Kentucky Space: Developed by NRP Partner KSTC***

Kentucky Space is a nonprofit enterprise involved in designing and developing educational, R&D and entrepreneurial space platforms. It is a consortium involving the students and the combined resources and capacities of the University of Kentucky, Morehead State University, the University of Louisville, Western Kentucky University, Murray State University, the Kentucky Community and Technical College System, the Kentucky Space Grant Consortium, and Belcan with support from the Kentucky Council on Postsecondary Education.

The managing partner and founder of Kentucky Space is Kris Kimel, CEO of the Kentucky Science and Technology Corporation (KSTC). Kimel developed Kentucky Space, as a result of his leadership KSTC joined the NRP in 2004 and developed relationships with NASA Ames experts and other NRP partner organizations. Kentucky Space has partnered with Houston based company NanoRacks, to utilize lab space for experiments on the International Space Station, and scheduled to launch on the Space Shuttle (STS-131) in April 2010.

Ky Sat-1 is also scheduled for a 2010 launch to test communications power systems and other space hardware. The Kentucky Space clean room and engineering lab are located at the University of Kentucky, Lexington and primary ground operations are out of Morehead State University, an hour away. The University of Kentucky and Morehead State University have an association with Stanford University and regularly bring students to NASA Ames to interact with NASA engineers and Stanford faculty, such as famed former Professor Bob Twiggs, inventor of CubeSat, on spacecraft design.





### *Ecliptic Enterprises Corporation: Shooting the Moon*

Forty years after Americans celebrated the first Moon landing, NRP tenant Ecliptic Enterprises Corporation has generated powerful images that have returned our attention back to the Moon's surface. The Lunar Crater Observation and Sensing Satellite (LCROSS) mission used the firm's RocketCam™ imaging system and payload-controlling avionics to relay images and data back to ground observers.

Data were used to confirm the presence of water within a permanently-shadowed crater on the Moon's south pole. Designed to withstand the extreme environment of space launches and travel through space, Ecliptic imaging technology will be incorporated into future missions to the Moon and Mars, as well as on launch vehicles and spacecraft in Earth orbit. Ecliptic's next NASA mission to map lunar gravity will launch in 2011.



LCROSS Satellite. Image Courtesy of Northrop Grumman, William Furlong, Artist



Dr. Kimberly Ennico Smith, LCROSS Payload Scientist, with Ecliptic avionics and camera and the rest of the LCROSS payload panel." (Photo Credit Ecliptic Enterprises Corp.)

## ***University Associates to Promote Green and Clean Technology***

The University of California Santa Cruz and Foothill-De Anza Community College District formed a public-private partnership to establish a new sustainable academic and research community on approximately 77 acres of land in NRP. The project will create an integrated sustainable community dedicated to bringing together research, education, and innovation while serving as a prototype for advanced green technologies and regenerative water and waste management systems.

The proposed development will deploy, evaluate and demonstrate environmental sustainability. It will be engineered for minimum carbon footprint by incorporating evolutionary best practices in proposed energy generation, conservation, potable water, and waste management. In addition, the proposed development will take advantage of existing Valley Transportation Authority light rail and its direct connection to CalTrain for a walk-able, bike-able, living environment with urban amenities. The project will include 1,930 residential units, of which 10 percent will be affordable, and 1.1 million square feet for academic facilities, industry, conference center, and other support uses. The UA anticipates a ground-breaking between 2013 and 2015, depending on market conditions.



Artist's Rendering of the UA-SVLLC Campus

### ***NRP Accomplishments & Awards***

*NASA-Google Inc. Ground Lease, 2008 Deal of the Year Award, San Jose Business Journal*

*ReQall, New York Times' 2009 Top 10 IXC-I-Phone application*

*Intrinsyx Inc., 2008 Small Business Subcontractor of the Year, NASA Ames Research Center*

*Tibion Inc., Silicon Valley's 2008 Emerging Technology Award for Medical Devices*

*KleenSpeed Inc., 2009 Winner at Mazda Raceway's First Alternative Vehicle Demonstration and Electric Time Trials in Monterey, California*

*CREST, California Space Grant Foundation grantee*

*Aprion Inc., M2M Magazine's top provider of "machine to machine" technologies*

*NASA-CMU-Google Inc. Global Connection Project, San Jose Tech Museum's 2006 Economic Development Award*

*Carnegie Mellon Innovation Laboratory, 2007 NASA Group Achievement Award for the Spaceward Bound 2006 Expedition in Chile*

*NASA Ames Development Plan, U.S. General Services Administration 2003 Real Property Innovation Award*

## ***Awards and Honors Recognize NRP Contributions***

NRP has been the focus of intense study since its inception. The National Research Council Science, Technology, and Economic Policy Board (NRC Board) found that NRP represented a "new model for industry-government partnerships" in its 2001 report, *A Review of the New Initiatives at NASA Ames Research Center: A Summary of a Workshop*. Ten years later, the National Research Council (NRC) issued a report, *Understanding Research, Science, and Technology Parks: Global Best Practices (2009)*, citing NRP as having "made great progress, exceeding expectations and enacting NASA plans with remarkable effectiveness." The NRC Board has noted that NRP is different from traditional science and technology parks:

- ▶ Traditional science and technology parks are oriented toward transferring technology and knowledge out to the external community;
- ▶ NRP provides a "two-directional" channel focused on (i) traditional NASA technology commercialization "out" to industry, and (ii) technology infusion "into" NASA by gaining access to knowledge and leading-edge technology from the external community;
- ▶ NRP serves as NASA access to Silicon Valley and California's research universities.

Both NASA and NRP partners have received multiple awards and honors, which illustrate the Center's importance in contributing to the community, and to the economy through innovations in technology. The NASA Ames Development Plan won the 2003 U.S. General Services Administration's highest award for *Best Real Estate Policy Innovation*, leading GSA Administrator Stephen A. Perry to note that "as our country changes, our mandate for excellence is creating an ever more responsive government to serve our citizens better...(the) NASA Ames Development Plan will provide an integrated, dynamic research and development community."



## **Community Outreach Programs Promote Sustainability and Space Exploration**

The NRP Office reaches out to the surrounding community in several important ways. The NRP hosts the Exploration Lecture series, with a mission to inspire the explorer in us. Past speakers have included renowned author Andrew Chaikin (*A Man on the Moon: The Triumphant Story of the Apollo Space Program*); Red Whittaker of Carnegie Mellon University, who led the university's 2005 entry in the Defense Advanced Research Projects Agency (DARPA) Grand Challenge Remote Robotic Vehicle Race; and astronaut Tom Jones, author of *Sky Walking: An Astronaut's Memoir*.

NRP also conducts technology showcases for business leaders to learn more about partnership opportunities with NASA, as well as activities of NRP tenants. In April 2009, NASA held its third Technology EXPO focused on the themes of exploration and sustainability. This open-to-the-public event attracted over 800 visitors from inside and outside NASA and Silicon Valley, including business leaders, local politicians, venture capitalists, and the media. This EXPO featured more than 40 exhibitors from NRP and NASA Ames scientists in areas ranging from electric power sources for cars to unmanned aerial vehicles uses to fight California wildfires. In parallel with the exhibits, 13 speakers gave short presentations on diverse topics such as "The Moon as a Window on Earth," "Advanced Life Support Systems," and "Supercomputing for Green Technologies."

NRP is also host to the Moffett Field Museum; the museum's mission is to acquire, preserve, and display artifacts which illustrate the roles performed by the various military commands assigned to or operating out of Moffett Field and educate the public on the airfield's rich heritage. Finally, the NASA Ames Exchange operates a gift shop at the Exploration Center that is open to the public daily.

## **NASA Ames Speakers Bureau**

The NASA Ames Speakers Bureau offers an invaluable service by providing speakers to the public. The Speakers Bureau presents programs and information to the educational community, libraries and museums as well as to professional, technical, civic, and social organizations. Speakers also participate in conferences, workshops, lectures, and staff NASA exhibits at local community events.

*The Center's robust program of public lectures and technology showcases not only connect the community to important topics in science, space, and the environment, but also provide an important venue for informal networking among technologists, educators, scientists, and the business community.*



NASA Research Park Exploration Lecture Series  
**Sky Walking: An Astronaut's Memoir**

**SKY WALKING**  
Tom Squires

Tuesday, March 11, 2008  
7 p.m. - 8:30 p.m. 943 Eagle Room  
FREE. Open to the public.  
www.nasa.gov

NASA Research Park Exploration Lecture Series  
**Shooting the Moon**

The Inside Story of Ranger 7 and the LUNAR PROBE  
The History of the Ranger 7 mission and the LUNAR PROBE  
The Ranger 7 probe was the first to provide images of the lunar  
surface from orbit.

Thursday, April 24, 2008  
7 p.m. - 8:30 p.m. 943 Eagle Room  
FREE. Open to the public.  
www.nasa.gov

NASA Ames Partnership Office  
**Technology Showcase**

Thursday, April 24, 2008  
7 p.m. - 8:30 p.m. 943 Eagle Room  
FREE. Open to the public.  
www.nasa.gov

NASA Research Park  
Exploration Lecture Series  
In partnership with the SETI Institute presents  
**SPACE EXPLORATION**  
Can gravity reverse aging?

May 4, 2005 @ 7:00 pm  
NASA Ames Research Center  
Building 943 - Eagle Room  
McRae Field Exit off Hwy 101

Open to the Public - Free Admission  
NASA Gift Shop open 6:00-7:00 pm  
Arrive early as seating is limited

Explore. Discover. Understand.  
www.nasa.gov  
www.researchpark.arc.nasa.gov

Featuring Author  
Dr. Jack Vermaas

The G-Connection - Harness Gravity and Reverse Aging  
Author available to sign books afterwards

NASA Research Park Exploration Lecture Series  
**Life Out There**  
What happens if we find it?

The NASA Research Park  
Exploration Lecture Series  
Wednesday, May 24  
7-9pm  
www.nasa.gov

A Lecture and Panel Discussion  
by Three Key Members of  
SETI Institute  
NASA Ames Research Center  
Moffett Field, CA  
Sponsored by Phillips Collaborative  
in partnership with SETI Institute

NASA Research Park  
Exploration Lecture Series  
**The 2006 Grand Challenge**  
RACING FOR THE FUTURE

Featuring Dr. William "Red" Whitaker  
Dr. William "Red" Whitaker  
Department of Mechanical Engineering  
Stanford University  
Thursday, June 28, 2006 @ 7:00 pm  
NASA Ames Research Center  
Moffett Field, CA  
Open to the Public - Free Admission  
www.nasa.gov

NASA Research Park Exploration Lecture Series  
**Revolutions in Space For ALL Humanity**

Thursday, June 28, 2006 @ 7:00 pm  
NASA Ames Research Center  
Moffett Field, CA  
Open to the Public - Free Admission  
www.nasa.gov

NASA Research Park Exploration Lecture Series  
**The View from the Center of the Universe**

Wednesday, Oct 25, 2006  
7 p.m. - 8:30 p.m. 943 Eagle Room  
FREE. Open to the public  
www.nasa.gov

NASA Research Park  
Exploration Lecture Series  
**Extreme Exploration**  
with Andy Clark and Beyond: The Science of Risk

March 13, 2008 - 7:00 pm  
NASA Ames Research Center  
Building 943 - Eagle Room  
Open to the Public - Free Admission  
www.nasa.gov

Featuring  
Author and Engineer  
John F. Ross

NASA Research Park Exploration Lecture Series  
**"Rocketman: Pete Conrad's Ride to the Moon, Mars & Beyond"**

Thursday, January 21, 2006  
7 p.m.  
Building 943, Eagle Room  
www.nasa.gov

NASA Research Park Exploration Lecture Series  
**From Earth to Mars**  
Steps Toward the First Human Mission to Mars

October 25, 2006  
Building 943, Eagle Room  
NASA Ames Research Center  
7:00 pm - 8:30 pm  
Free Open to the Public  
www.nasa.gov

NASA Research Park Lecture Series - <http://researchpark.arc.nasa.gov/>



### Forums and Seminars Expand Community Outreach

NASA Ames hosts a wide variety of forums, conferences, and seminars every year that give local businesses an opportunity to learn about NASA research and development activities, meet others with similar research interests, and establish collaborative research or business relationships with both NASA scientists and among themselves.

In 2007, NASA Ames organized and sponsored a Small Spacecraft Industry Day which brought together over 160 attendees from 80 different U.S.-based companies to discuss NASA Ames' vision and technology needs for the development of Small Spacecraft. The event consisted of formal presentations by Ames staff and more than 75 one-on-one meetings between Ames and industry representatives. The event resulted in over 100 new proposals for the Small Business Innovation Research and Small Business Technology Transfer Programs.

Another noteworthy event was the 2008 Patent Awards ceremony. The event honored NASA Ames researchers who collectively have been issued 48 patents by the U.S. Patent Office since 2004. The event provided an opportunity for the Center to thank its researchers for helping to build Ames' intellectual portfolio for partnership development and to promote the value of patents to both private researchers and researchers at NASA Ames.



Display from Small Spacecraft Industry Day, June 2007



Exploration and Sustainability Expo





## ***Measuring the Economic Benefits of NRP***

As NRP continues to build out, it will generate major economic benefits to the Bay Area, California, and the nation. This section presents a detailed analysis of the NRP project, estimating both construction benefits stemming from current development plans, as well as operational impacts which will be ongoing.

### **NRP Development Plan**

Adopted in late 2002, the NASA Ames Development Plan (NADP) envisions 5.7 million square feet to be developed in the NRP for office, R&D, university classrooms and labs, housing, museums, and a conference and education center. Much of this development will be new construction, but a portion will include the renovation of historic structures in the Shenandoah Plaza Historic District, which is located within the NRP. The NADP also calls for development of 1,930 residential units (1.8 million square feet) to support a balance of jobs and housing as development of the NRP moves forward.

Phasing of construction is assumed to occur over a 15-year period, based upon information provided by partners. Total NRP construction is approximately \$2.4 billion in 2008 dollars.

BAE's analysis of the economic impacts of the construction of the NRP is based on estimates of development phases given to NASA by NRP partners, notably Planetary Ventures, LLC which has leased approximately 42 acres of land in the Bay View Planning District, as well as the University Associates-Silicon Valley LLC which has leased approximately 77 acres of land in the South Campus Planning Area. Additional data regarding construction assumptions are presented in Appendix C.

## Employment and Economic Stimulus of NRP From Construction

Table III-2 shows the direct, indirect, and induced regional, statewide, and national impacts from the proposed development's construction phase. As indicated, construction activity will provide the region with just under \$4.0 billion in economic benefits, and support approximately 1,700 new jobs over the 15-year construction period (e.g., 1,220 jobs provided annually for 15 years). Statewide, construction will generate approximately \$4.2 billion of economic activity and 1,900 jobs. Nationally, NRP construction will stimulate \$6.4 billion total of economic activity and approximately 2,800 total jobs.

**Table III-2.** NRP Construction Direct Impacts (2009 \$) (a)

Geography/Impacts (b)	Direct	Indirect	Induced	Total
<b>Bay Area (c)</b>				
Output	\$2,448,900,000	\$727,990,000	\$804,955,000	\$3,981,845,000
Employment (d)	1,064	288	386	1,737
<b>California</b>				
Output	\$2,448,900,000	\$844,580,000	\$949,683,000	\$4,243,163,000
Employment (d)	1,064	357	495	1,916
<b>United States</b>				
Output	\$2,448,900,000	\$1,891,036,000	\$2,033,994,000	\$6,373,930,000
Employment (d)	1,064	720	1,062	2,847

**Notes:**

(a) Includes impacts from Google Inc., NRP Tenants, and UA-SV LLC.

(b) All impacts reported in 2009 dollars.

(c) Bay Area nine-county region includes counties of: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma

(d) Assumes a construction phase of 15 years, active construction for commercial and residential development; 8 years, active construction for infrastructure.

Sources: IMPLAN, BAE, 2009.





Construction-site for new ARC building, NASA Ames Campus



Drilling for renewable energy: geothermal wells for new ARC building, NASA Ames Campus

### ***NRP Construction Multiplier Effect***

Dividing each region's total output by its direct output indicates the economic multiplier that measures the economic activity of every dollar spent. Thus, every dollar of economic activity that would occur from the construction phase would generate approximately \$1.62 in total regional economic activity, \$1.73 within the State, and \$2.60 total within the Nation.

### **Employment and Economic Stimulus of NRP at Full Operation (2024)**

Ongoing operations at NRP also contribute to the regional, statewide, and national economies. This section estimates ongoing annual NRP operations impacts using employment estimates for NRP on full build-out and occupancy. Based on assumed employment densities per land use, when fully developed and occupied, NRP will be the location of approximately 11,530 employees working at NRP-tenant organizations (see Table III-3).

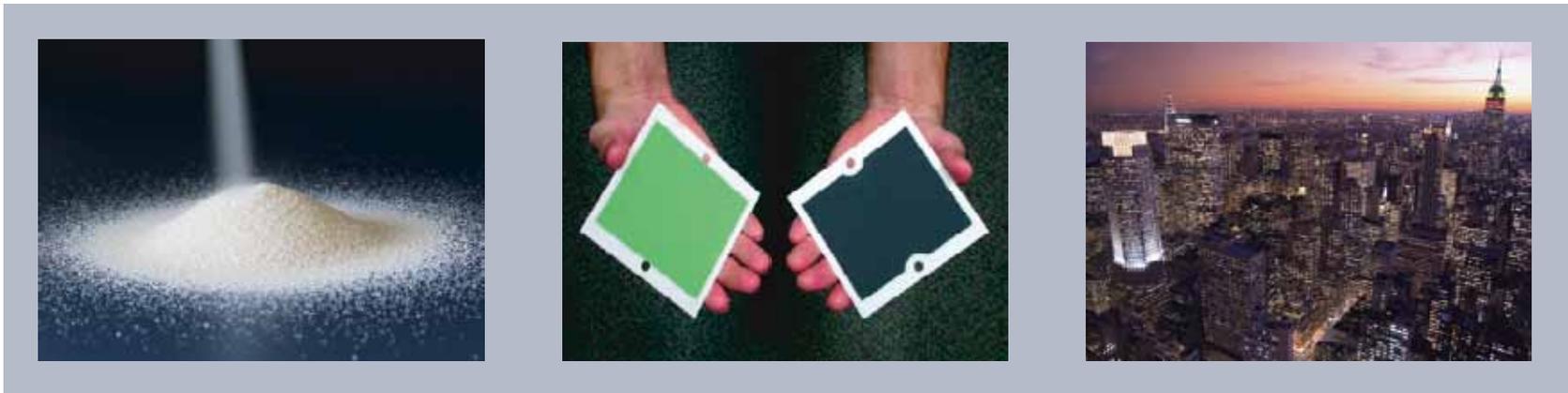
NRP tenant employees generate output that flows through the local economies to generate annual impacts from ongoing NRP tenant operations. Table III-5 shows the direct, indirect, and induced benefits from NRP annual operations, which provides the region with \$4 billion in total annual economic impacts, and supports approximately 21,384 permanent jobs. California would expect to gain \$4.2 billion in total annual economic activity and 23,576 jobs. Nationally, NRP will generate 33,793 jobs and \$5.8 billion in total annual output.

### **NRP Operations Multiplier Effect**

Dividing each geography’s total output by its direct output provides a measure of the economic activity generated throughout the economy of ever dollar spent. Thus, for every dollar of economic activity from operations, NRP will generate approximately \$1.77 in total regional economic activity, \$1.85 within the State, and \$2.56 total within the nation.

### **NRP Tax Impacts**

According to IMPLAN, NRP’s economic activity within Santa Clara County will result in total state and local taxes of approximately \$128.7 million annually. Economic activity within the State would result in total state and local taxes of approximately \$164 million annually (including economic activity generated within Santa Clara County). Table III-4 shows the total tax impacts from the county and state models.



NRP Partner Bloom Energy’s Revolutionary Technology Generates Clean Tech Jobs



**Table III-3. NRP Economic Impacts at Full Operation (2009 \$)**

Geography/Impacts	Direct	Indirect	Induced	Total
<b>Bay Area</b>				
Output	\$2,262,795,000	\$885,250,000	\$863,984,000	\$4,012,029,000
Employment	11,527	4,591	5,266	21,384
<b>California</b>				
Output	\$2,262,795,000	\$926,997,000	\$1,005,619,000	\$4,195,411,000
Employment	11,527	5,378	6,671	23,576
<b>United States</b>				
Output	\$2,262,795,000	\$1,527,248,000	\$2,003,111,000	\$5,793,154,000
Employment	11,527	8,885	13,381	33,793

## Notes:

(a) Includes impacts from Planetary Ventures LLC (Google, Inc.), tenants, and UA-SV LLC. (b) All impacts reported in 2009 dollars. (c) The nine-county Bay Area region includes the following counties: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma. (d) Assumes a construction phase of 15 years, active construction for commercial and residential development; 8 years active construction for infrastructure.

Sources: IMPLAN; Bay Area Economics, 2009

**Table III-4. NRP Tax Impacts, Santa Clara County and State of California**

Tax Recipient/Tax Category	Santa Clara County	California Total
State/Local Govt Non Education		
Corporate Profits Tax	\$7,588,207	\$8,922,425
Dividends	\$12,059,136	\$14,179,469
Indirect Bus Tax: Motor Vehicle Lic	\$736,165	\$926,064
Indirect Bus Tax: Other Taxes	\$7,705,859	\$9,693,642
Indirect Bus Tax: Property Tax (a)	\$7,006,591	\$8,813,994
Indirect Bus Tax: S/L NonTaxes	\$3,190,718	\$4,013,788
Indirect Bus Tax: Sales Tax	\$37,944,010	\$47,731,954
Indirect Bus Tax: Severance Tax	\$12,714	\$15,994
Personal Tax: Estate and Gift Tax	\$0	\$0
Personal Tax: Income Tax	\$39,537,823	\$49,450,531
Personal Tax: Motor Vehicle License	\$1,255,052	\$1,599,292
Personal Tax: NonTaxes (Fines- Fees)	\$7,678,805	\$9,964,351
Personal Tax: Other Tax (Fish/Hunt)	\$272,304	\$309,819
Personal Tax: Property Taxes	\$433,177	\$615,202
Social Ins Tax- Employee Contribution	\$624,808	\$1,468,619
Social Ins Tax- Employer Contribution	\$2,688,125	\$6,318,475
<b>Total: State/Local Government</b>	<b>\$128,733,494</b>	<b>\$164,023,619</b>

## Note:

(a) Only includes property tax revenues from Google Inc. office space.

Sources: IMPLAN; BAE, 2009.



***PART IV:***

**AMES + NRP DRIVE REGIONAL ECONOMIC DEVELOPMENT**





## Part IV: Ames + NRP Drive Regional Economic Development

NASA Ames supports the local and regional economy not only through its direct jobs and purchases but through maintaining its specialized research facilities for use by third parties actively-seeking commercial partnerships, operating Moffett Federal Airfield, sponsoring forums, conferences, and seminars as well as cultivating strong relationships with local economic development officials and regional economic development organizations. Finally, by being a steward of sensitive natural and cultural resources, NASA Ames contributes to the high quality of life that makes the Bay Area an attractive place to work and live.

This section of the report discusses the variety of ways that NASA Ames and the NASA Research Park drive the regional economy, contributing to the overall quality of life and heritage of technological advancement in the region. It also discusses potential challenges to economic growth, and how NASA Ames can address these challenges.

### ***Ames Research Center Powers Regional Economic Development***

The Bay Area has one of the largest concentrations of federal, academic, and industrial research and development organizations in the nation, giving the region a tremendous competitive advantage and high levels of output and productivity. In turn, NASA Ames is one of the key linchpins in the Bay Area's innovation economy. For example, of the 17 Bay Area research institutions—with a combined total of just over \$5 billion in annual R&D budgets—NASA Ames ranks among the top half in research spending (see Table IV-1 on the following page)

*“Research and experience have shown that not only assets like talent, capital, and physical infrastructure, but regional networks, culture, and community quality of life are critical cornerstones for regional innovation.”*

*Bay Area Economic Institute, The Innovation Driven Economic Development Model, 2008.*



**Table IV-1.** Bay Area Research Infrastructure Annual Operating Budget, FY 2009 (a)

Institution	Location	Estimated 2009 Annual Budget (\$ million)	Estimated 2009 Research Budget (\$ million)
Sandia National Laboratories- California (b)	Livermore	\$2,250	\$2,217
Lawrence Livermore National Laboratory	Livermore	\$1,497	\$1,379
Stanford University	Palo Alto	\$5,093	\$1,031
University of California, San Francisco	San Francisco	\$2,972	\$662
U.S. Geological Survey (c)	Menlo Park	\$1,046	\$649
Lawrence Berkeley National Laboratory	Berkeley	\$648	\$496
University of California, Berkeley	Berkeley	\$2,123	\$482
NASA Ames Research Center	Mountain View	\$611	\$356
SRI International	Menlo Park	\$367	\$344
University of California, Santa Cruz	Santa Cruz	\$531	\$121
San Jose State University	San Jose	\$263	\$68
J. David Gladstone Institute	San Francisco	\$55	\$55
Hoover Institution	Palo Alto	\$34	\$34
Stanford Linear Accelerator Center	Palo Alto	\$29	\$29
Lick Observatory, U.C. Santa Cruz	San Jose/Santa Cruz	\$8	\$8
Santa Clara University	Santa Clara	\$322	\$5
Joint Genome Institute- DOE	Walnut Creek	NA (d)	NA (d)
<b>TOTAL</b>		<b>\$14,533</b>	<b>\$5,070</b>

**Notes:**

(a) FY 2009 for academic institutions refers to 2009-2010 academic year.

(b) Total budget for Sandia National Laboratories nation-wide. Budget for Livermore, CA facility is not specified.

(c) Total budget for U.S. Geological Survey. Budget for Western Region office in Menlo Park is not specified.

(d) Budget information included in data for Lawrence Livermore National Laboratory

Sources: Budget Reports: Stanford University, UCSF, UCB, SJSU, 2009-2010; Sandia National Laboratories, website, January 2010; Lawrence Livermore National Laboratory 2010 Annual Report; USGS Greenbook Budget Report, FY 2010; Lawrence Berkeley National Laboratory, Finance Department, January 2010; SRI International, Department of Finance, 2010; Santa Clara University Finance Department, 2010; BAE, 2010



## Secure Federal Airfield Supports Medical and Disaster Response

The NASA Ames Development Plan authorizes the continued use of Moffett Field as a limited use federal airfield. NASA Ames' stewardship of Moffett Field encourages the commercial use of space by permitting NASA Space Act partners such as Lockheed Martin and Space Systems Loral to conduct flight operations. The airfield is also utilized for research and education programs by private entities that contribute to airfield operating costs.

The airfield is also the home to the 129th Wing of the California Air National Guard and is used for rescue/disaster response by the Santa Clara Sheriff and Stanford University Hospital's Life Flight. Moffett Field is the preferred airfield for Air Force One and other federal aircraft transporting government officials to the Bay Area.

### Military and Federal Resident Agencies

NASA Ames is home to several other federal agencies situated on-site under a variety of agreements. These agencies include the California Air National Guard (129th Rescue Wing), U.S. Army Civil Affairs and Psychiatric Operations Command, Federal Emergency Management Agency, U.S. Army (leasing operations at the National Full-Scale Aerodynamics Complex wind tunnel), and Defense Commissary Agency. Together these resident federal agencies employ between 1,170 and 1,470 workers.

### NASA Ames Disaster Assistance and Rescue Team

NASA Ames' Disaster Assistance and Rescue Team (DART) was formed in 1986 and today is a fully functional emergency response team that is not only capable of dealing with potential disasters at NASA Ames but also prepared to respond to off-campus disasters as a fully functional urban search and rescue team. DART is one of the nation's most qualified and best-equipped emergency response teams. For more information regarding NASA DART capabilities, refer to the FEMA National Response Plan under "Emergency Support Function #9," at the Urban Search and Rescue Annex (<http://www.fema.gov/emergency/usr/esf9.shtm>).



DART Exercise # 2: Response to Terrorism



Carnegie Mellon University Partnered with NASA Ames to Launch Disaster Management Initiative (DMI). Photo taken at March 24, 2010 kickoff event



2002 DART Exercise: Response to Terrorism

Approximately 250 NASA Ames personnel support DART. Most members are volunteers and come from most sectors of NASA Ames. The team is composed of a large range of NASA employees, including scientists, engineers, wind tunnel mechanics, facilities personnel, computer programmers, carpenters, plumbers, electricians, and heavy equipment operators who all volunteer their time to DART responsibilities. Once an individual joins the team, training and responsibility for emergency medical response, search and rescue, and handling of specialized equipment become an official part of his or her job function at the Center

### **Accommodating Local Public Safety Agencies and Hospitals**

NASA Ames also serves as a regional center for disaster response and emergency services training. The California Highway Patrol, San Jose Police Department, and other local law enforcement agencies and fire departments utilize NASA Ames facilities for training exercises. Moffett Field is a preferred landing site for the transportation of organs for transplants to and from local hospitals. All of these users contribute to the financial costs of operating NASA Ames and Moffett Field.





### ***UAV Collaborative: Using Drones to Aid Rescuers***

The nonprofit UAV Collaborative has been based in NRP since 2004 and boasts San Jose State University, Honeywell International, Cirrus Digital Systems, Xtreme Aerial Concepts, MLB Company, Empirical Systems Aerospace and Lockheed Martin among its partners. Fuel efficient, reasonably priced unmanned aerial vehicles (UAVs), also known as “drones”, have the potential to stay aloft for significantly longer time periods than piloted craft.

Low altitude UAVs flying under 5000 ft. have tremendous potential for effective emergency response and disaster assistance when multiple craft in the sky stream data 24 hours a day, aiding the success of challenging missions such as atmospheric sampling, fire fighting and urgent search-and-rescue operations.

By showcasing and advancing NASA-developed technologies, the UAV Collaborative provides tangible benefits to other federal and state agencies, including the National Forest Service for which UAVs can collect fire-related thermal imagery during a major wildfire event to help improve real-time information.





*The MARS 30X, a wind powered aerostat generator developed by Magenn Power, rotates about a horizontal axis in response to the wind, generating electrical energy which is transferred down a tether to the ground. The 30X deploys at 1,000 feet where the wind speed generally doubles, increasing the potential wind power four fold. In partnership with Magenn, Airship Earth is designing antenna and sensor systems as powered aerostat rotor payloads. Image courtesy of Airship Earth*

### ***Airship Earth and Magenn Power: Infrastructure for Emergency Response***

Airship Earth, a new media production, technology and telecommunications group, is a member of the NASA Research Park community of academic, industry and government partners. The group's central focus is building highly interactive, ultra-scale visualization display systems and support networks. The displays and associated programs are being developed to acquire, compress, stream, synchronize, fuse and visualize multidimensional/multivariate datasets used in emergency response, education and entertainment.

Airship Earth's near-term goals include developing more powerful and intuitive tools to visualize and fuse data linked to cross-platform communications systems, through interactive displays that are referred to as Common Operating Pictures, which serve "Communities of Trust" involved with emergency response. The display systems will provide Incident Commanders and First Responders with ever more effective ways of exploring, analyzing and processing massive and complex data and converting data into "actionable intelligence" and coordinated, coherent

response. Airship Earth is collaborating with Carnegie Mellon Silicon Valley, also based at NRP, Geodan, Geoinformatics specialists based in the Netherlands, ESRI, Microsoft and researchers at NASA Ames Research Center in this effort.

Airship Earth entered into a Teaming Agreement with Magenn Power to co-develop lighter-than-air, wind powered aerostats that can provide emergency power in disaster areas. Airship Earth's objective in teaming with Magenn is to develop rapidly deployable emergency power generation systems. Additionally antenna and surveillance payloads on the aerostats are being developed by Airship Earth to restore cellular and radio communication and provide high resolution, continuous surveillance over landscapes impacted by natural and manmade disasters. As operational experience builds and funding becomes available, the team intends to fly the aerostat with increasingly capable communications and surveillance payloads. Pierre Rivard, CEO of Magenn Power expressed enthusiasm about the teaming agreement with Airship Earth, "Airship Earth has been a godsend to Magenn Power. Though this teaming agreement, our R&D efforts can accelerate rapidly at the NASA Research Park, and nearby NASA Ames Research Center, one of the world's premier research centers."



*NASA Ames and NRP provide a wealth of formal and informal venues for interaction, contributing to the region's culture of innovation and leading to new ideas for technologies, products, and services.*

## ***NASA Brand Enhances Regional Economic Development***

NASA has a powerful global brand and positive image. NASA Ames and NASA Research Park raise the “tech-savvy” image of nearby communities, offering a boost to the marketing efforts of economic development professionals in the surrounding communities of Mountain View and Sunnyvale.

By partnering with major research universities such as the University of California, Carnegie Mellon University, and the California State University system, NASA Ames also creates a powerful critical mass of students and researchers that businesses find attractive. Businesses seek locations in or close to NASA Research Park to gain access to faculty, students, and NASA scientists, supporting local economic development promotional efforts.

NASA Ames developed the NRP in partnership with the neighboring cities of Mountain View and Sunnyvale. NASA Ames has active, productive relationships with R&D and economic development advocacy organizations including:

- ▶ Joint Venture—Silicon Valley Network;
- ▶ Silicon Valley Leadership Group;
- ▶ Bay Area Council Economic Institute;
- ▶ Bay Area Bioscience Center;
- ▶ Northern California Nanotechnology Initiative;
- ▶ Bay Area Science and Innovation Consortium.

These relationships connect NASA Ames to the Bay Area business community, with mutual benefits to both the Agency and industry.





### ***Airship Ventures: Promotes Regional Tourism***

One of the more visible promotional opportunities serving the entertainment, tourism and research markets, is the NRP-based Airship Ventures. As the nation’s first commercial passenger airship service in over 70 years, this “lighter than air” airship has been profiled repeatedly in regional and national media, garnering strong local attention and support, as well as attracting visitors and event attendees to NASA Ames to board the airship.



This unique commercial venture offers a new perspective on the planet, with “flightseeing” destinations in the South Bay, San Francisco, Monterey Bay, Los Angeles and San Diego. The 246-foot-long Zeppelin NT is the largest airship flying in the United States, carrying up to twelve passengers at a time. It is available for special events and corporate rental.



Through its partnership with Airship Ventures, NASA not only supports the regional tourism infrastructure but also provides other direct benefits to the Agency. The firm has restored airship use of historic Hangar 2, originally constructed as a Moffett Field airdock in 1943, and re-used historic Building 20, the former Bachelor Officer Quarters. Airship Ventures and NASA have identified over 50 potential collaborative projects including using the airship as a platform for airborne science and in disaster response scenarios. The airship has already conducted a research project with NASA and the Search for Extraterrestrial Intelligence (SETI) program in support of the South Bay Salt Ponds reclamation engineering, which garnered national media coverage.





### Technology Start-Ups Relocate to Nearby Communities

One of the most direct benefits of NASA Ames in support of local economic development has been the dramatic growth of several Ames tenants. Nurtured on-site, these tenants have grown rapidly and elected to expand operations in Mountain View and Sunnyvale.

- ▶ Apprion Inc., a developer of integrated wireless security infrastructure, started in NRP and quickly expanded to a full wing of Building 19. To meet its growth and facility needs, Apprion then relocated to Shoreline Business Park in Mountain View, where it continues to thrive;
- ▶ Bloom Energy Inc., a cutting edge fuel-cell technology company, expanded into 40,000 square feet of office space in Sunnyvale. It has kept its NRP facility fully operational, (now being devoted primarily to testing and research and development) and plans additional improvements to its NRP operations.



## Addressing Regional Barriers to Economic Development

While it is clear that the Bay Area's economic performance has been historically strong and that there is a positive outlook for the region's economy in the foreseeable future, the following regional factors have the potential to impede economic growth if they are not effectively addressed:

- ▶ Shortage of skilled labor;
- ▶ Lack of affordable housing;
- ▶ Worsening levels of traffic congestion.

These potential constraints tend to act as disincentives for new business ventures to start up in the Bay Area, diverting attention to the more affordable and accessible Central Valley of California or the states of Oregon and Washington, or other parts of the United States. Notwithstanding a short-term easing of these issues due to present weak economic conditions, NASA Ames has worked with local economic development organizations to continue to focus on long-term solutions.

NASA Ames is making its own fair-share contribution to addressing these regional economic development issues by:

- ▶ Improving primary and secondary education in Bay Area schools, with special emphasis on STEM education;
- ▶ Providing for the production of new workforce housing through the approval of 1,930 residential units as part of the NASA Research Park project;
- ▶ Adopting an aggressive transportation demand management program to encourage the use of alternative transit to NASA Ames and NASA Research Park and minimize NASA Ames's traffic impacts.



Conceptual medium-density housing from the 2002 NASA Ames Development Plan



A nesting Killdeer outside Building N-201 at NASA Ames

## Quality of Life

The Bay Area offers a high quality of life that is important in attracting and retaining highly skilled labor and executive talent. In fact, quality of life is considered a major factor behind the region's economic success. NASA contributes to the region's quality of life through its public outreach and natural resource stewardship programs, including:

**San Francisco Bay Trail.** NASA Ames has participated in a federal, state and local effort to improve recreational access to the San Francisco Bay by facilitating opening additional sections of the 500-mile Bay Trail, such as the Moffett Gap at the north end of NASA Ames.

**Cultural Tourism.** Associated with the completion of the Bay Trail and restoration of the salt marshes, NASA Ames is cooperating with the U.S. Fish and Wildlife Service to develop interpretative signage that links the history of NASA Ames—including the former Naval Air Station at Moffett Field—to the history and ecology of the Bay.

**Burrowing Owl Habitat.** Burrowing owls were once the most common migratory bird in the Bay Area, and along with other owl species, play a role in controlling insects and small rodents that cause economic harm. Due to land development and ground squirrel eradication, burrowing owls are now a Federal and State species of special concern. In addition to setting aside 40 acres of owl preserve areas within the approximately 2,000-acre Center, NASA Ames has adopted a risk or safety based approach to managing habitat and abating ground squirrels outside the preserves.

**Wetlands Preservation and Restoration.** In one of the nation's largest wetlands restoration projects, NASA technology is helping state and federal government reclaim 15,100 acres of salt evaporation ponds in the San Francisco Bay. For example, the U.S. Fish and Wildlife Service and the California Department of Fish and Game recently purchased salt ponds from the Cargill Salt Company for \$100 million. A small group of NASA scientists and technicians is studying the salt evaporation ponds using sensors on satellites, airplanes, the Airship Ventures Zeppelin-NT, as well as surface sampling, to learn how restoring the ponds to approximate their natural state may affect local ecology. Scientific instruments that NASA scientists are using in the San Francisco Bay salt ponds recovery effort include the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) on the Terra satellite; the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument on the Terra and Aqua satellites; and the thematic mapper on the Landsat 5 satellite.

**Reclaimed Water.** NASA Ames is taking steps to use reclaimed water from the City of Sunnyvale and reduce demand for potable water from the Hetch Hetchy Reservoir and indirectly reduce stress on Delta fisheries. In addition, the city of Mountain View will soon have reclaimed water available closer to the new areas of development for Planetary Ventures, LLC, and University Associates.

**Remediation.** NASA Ames along with the Navy and the "MEW" companies are remediating (cleaning up) and restoring contaminated sites at NASA Ames. As these sites are restored, they have become available for reuse by partners and tenants in the NASA Research Park.



Stevens Creek Trail in Mountain View (Bridge at Whisman Park)



Combined Federal Campaign contribution coordinators

### Helping Those in Need

NASA Ames is the largest contributor among federal agencies in the San Francisco-Oakland-San Jose region to the Combined Federal Campaign. In support of the campaign, representatives from 59 Ames organizations communicated CFC news, posted events and recorded contributions. The 2009 Combined Federal Campaign at NASA Ames raised \$282,727, exceeding the Center's goal of raising \$250,000 to help all Americans through times of need such as natural disasters or periods of personal hardship.



# Acknowledgements

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